IMPERIAL BUREAU OF MYCOLOGY
1 MAY. 1922

REPORT

OF THE

Department of Plant Pathology

OF THE

New Jersey Agricultural College Experiment Station

New Brunswick, N. J.

BY

MELVILLE T. COOK, PH.D.

FOR THE YEAR ENDING
JUNE 30, 1920

TRENTON, N. J.
PUBLISHED BY THE STATE
—
1921

REPORT OF THE DEPARTMENT OF PLANT PATHOLOGY

W. H. Martin—
1. Relation of sulfur to soil acidity and the control of potato scab.
2. Physiological studies of *Actinomyces scabies*.
3. Studies of physiological diseases of potatoes.
4. Relation of soil reaction to the growth of pathogenes.

C. M. Haenseler—
1. Fungi injurious to paints.
2. Spraying pears for the control of leaf and fruit spot.
3. Spraying cherries for the control of leaf spot.
4. Eggplant wilt.

R. F. Poole—
1. Root rot of celery.
2. Root rot of horseradish.
3. Control of diseases of sweet potatoes.
4. Control of the diseases of tomatoes.

The following publications have been issued from the department during the past year:

W. H. Martin. Relation of sulfur to soil acidity in the control of potato scab. *In* Soil Science, vol. 9, no. 6; June, 1920.

W. S. Krout. Common diseases of celery. New Jersey Agricultural Experiment Station. Circular 112.

Mr. Krout was formerly laboratory assistant and graduate student in the department and this circular is the result of studies made here. He is now connected with the Massachusetts Agricultural Experiment Station.

EPIDEMICS

The rainfall during the spring, summer and fall of 1919 was heavier than usual and the losses due to plant diseases much heavier than usual. Several diseases were severe enough to be listed as epidemics. They are as follows:

1. *The brown rot of the peach* was exceptionally severe in both 1919 and 1920. It is the subject for special study and is discussed more fully on page 572.
2. *The late blight of the potato* was exceptionally severe in 1919, especially on the late crop. A more complete discussion will be found on page 577.
3. *Potato scab* was more severe than usual in 1919. It is the subject of special study by Dr. W. H. Martin. His report on this subject will be found on pages 587-598.
4. *The root rot* of the pea was very severe throughout the southern part of the state in 1919. It was most destructive in Burlington County and was the cause of heavy losses. This disease occurs every year and always causes considerable loss, but in 1919 it was much more destructive than usual. It should be the subject of special study.
5. *Leaf fall* of many trees was especially severe during the spring and summer of 1919. The first complaints were concerning the beech of parks, streets and private estates, but later the complaints were made with reference to apple, peach and other trees. This entire subject is more fully discussed on pages 570-573.

6. *The leaf and fruit spot* of the pear and quince (*Fabrea maculata* (Lev.) Atk.) was exceptionally severe in 1919. Experimental work for the control of this is to be conducted by Mr. C. M. Haenseler.
7. *Stem cankers on tomatoes and cabbage* were reported from several points in the southern part of the state in 1919 and in some cases were the cause of heavy losses. The same disease was reported on peppers in 1920. It was due to *Rhizoctonia* and is primarily a seed-bed disease. Although this disease has been reported from other states, 1919 was the first year in which we have any record of its occurrence in this state.
8. *The stem rot of sweet potatoes* was no more severe than usual. It is always the cause of heavy losses and should have received attention long before this. Recent appropriations have made it possible to study this and other diseases of the sweet potato both in the field and in storage. R. F. Poole of this department has been assigned to this work, and will begin July 1, 1920.

OTHER IMPORTANT DISEASES

Because of the very wet season in 1919, a number of other diseases were of more than usual importance. They are as follows:

1. *Sun scald of the apple.* This injury was very severe throughout the greater part of the state, especially the southern half. It was due to the exceptionally high temperature on July 4 and 5. The part of the surface of the apple exposed to the direct rays of the sun became hard and black and in some exceptionally severe cases caused a cracking later in the season.
2. *Spray injury of the apple* was very severe in some orchards in which the concentrated lime-sulfur 1 to 40 was used. Self-boiled lime-sulfur used on trees of the same varieties in the same orchard gave excellent results and no injury.
3. *The black leg of cabbage* was very severe in localities in South Jersey. It is the opinion of the writer that a survey should be made to determine the severity of this disease, the amount of loss and the best methods for its control. Efforts for its control without this information are very likely to be misdirected. It is a problem for the trained plant pathologist.
4. *The root rot of celery* has been the subject of special study by W. S. Krout (formerly of this department) and by R. F. Poole. The trouble is due to two or possibly more organisms, and the symptoms are variable. It has been demonstrated that these organisms can be controlled by the proper seed-bed treatment but war conditions resulted in neglect on the part of many growers. This work is now ready for extension propaganda but the work should be carried on by a man trained in plant pathology who will be able to recognize the organisms and to overcome certain difficulties which are likely to arise.
5. *The root rot of corn* is a disease which is distributed throughout the state. It is especially severe in Salem County but occasionally causes considerable losses in other localities. We have been cooperating with the United States Department of Agriculture in the study of this disease. The records of this cooperation are appended to this report (pages 598-604). Because of the lack of funds the government support has been withdrawn but we are continuing the work.

6. *The root rot of horse-radish* is the cause of heavy losses in the northern part of the state especially in Passaic County. This has been the subject of study by Mr. Poole and is discussed on page 610 of this report.
7. *The leaf fall of the pepper* has been the cause of many complaints during the past three years. Thus far we have been unable to determine the cause of this disease but it results in rather heavy losses. It should receive careful consideration by a pathologist who can devote the necessary time to the work.
8. *The scab of wheat* causes a much greater loss than the growers realize. It is closely associated with the root rot of corn and should be studied in connection with that disease.
9. *The cherry leaf spot* was very severe, completely defoliating many trees and checking their growth before the close of the growing season. We are giving some attention to its control this year.
10. *The diseases of small fruits* are the cause of very heavy losses but are not generally recognized by the growers. A survey and brief study of these diseases followed by the proper extension propaganda would result in very great savings to the growers of small fruits.
11. *The melon and cucumber losses* due to diseases in 1919 were greater than usual. *Sclerotinia libertiana* Fckl., which is usually a serious disease on these crops when grown under glass, was quite severe in some fields. The control of some of these diseases would no doubt increase the melon and cucumber industry of the state.

COOPERATIVE WORK WITH THE STATE DEPARTMENT OF AGRICULTURE

A great deal of work of this department is very closely associated with the work of the New Jersey State Department of Agriculture.

1. *The inspection of nurseries* shows them to be in an exceptionally good condition so far as freedom from plant diseases is concerned. Our nurserymen do not handle the chestnut stock; a phase of the industry which was destroyed by the chestnut blight.
2. Very few of the common or European *barberries* are to be obtained in our nurseries, partly because of the quarantine restricting their shipment and partly because the Japanese barberry is a much more desirable plant for ornamental purposes.
3. *The blister rust on the white pine* has not been found in the state except in four nurseries. The blocks of trees in which it was found are under quarantine. The disease has been found on currants in two places, which also are quarantined.
4. It is impossible to inspect the nurseries for *crown gall and hairy root* but we have every reason to believe that very little if any of this disease goes out from the nurseries of the state. However, it is necessary to conduct very rigid inspections for this disease on stock coming into the state.
5. There has been some agitation in the state for an inspection of peach orchards in an effort to reduce *peach yellows and little peach.* The writer is inclined to believe that work of this kind cannot be carried on successfully at this time.
6. During the past year we began the inspection of *home-grown seed potatoes.* This work is very promising and a complete statement can be found in the reports of the State Department of Agriculture.

NEEDS OF THE DEPARTMENT

The force of workers in this department is not large enough to meet the many demands on us. The most urgent needs are as follows:

1. We need a well trained extension plant pathologist who can care for many calls which must now be cared for by those whose time should be given to research work. We wish to emphasize that the man in charge of this work should be a trained plant pathologist; a man who can recognize the diseases in their many variations, a man who can distinguish between diseases showing very similar symptoms although due to radically different causes, a man who can diagnose causes for failures in demonstrations and who recognizes the importance of environmental factors. Extension work on plant diseases by men not trained in plant pathology has resulted and will continue to result in more or less blunders and waste of public funds.
2. We need a man to conduct experimental work on strains resistant to diseases. This very important field is receiving a great deal of attention in the departments of plant pathology of many other agricultural experiment stations. Such a man should be well trained in plant pathology and should also have some knowledge of genetics. This is one of the most promising fields for research at the present time.
3. Many of our most important diseases are due to soil organisms. These forms are receiving a great deal of attention throughout the country. They present a number of very promising lines of study and we should give more attention to them.
4. The wilt diseases are becoming more and more important from year to year. They are usually due to soil organisms and should be studied by a well trained plant pathologist.
5. The mosaics and similar diseases (peach yellows, little peach, etc.) are very little nearer solution than they have been for many years past. They present very important and very difficult problems for research.
6. The diseases of grains and forage crops are causing much greater losses than we realize and should receive attention.
7. The diseases of small fruits are also taking heavy tolls and should receive attention or these industries will be greatly reduced within the next few years.
8. Many of the storage rots of fruits and vegetables, especially the sweet potato, are due to the same organisms that cause heavy losses in the field. They are of great economic importance and should be studied by well trained men.

THE HERBARIUM

The herbarium, which was at one time an exceptionally good collection of plants for study, has been neglected for many years. The mounted plants should be gone over very carefully and put in place and the large collection of unmounted plants should be mounted and carefully distributed so that they can be used. Prof. G. W. Martin has given some attention to this work during the past year but his time has been very limited.

DISEASES OF THE YEAR

Alfalfa

Leaf Spot (*Pseudopeziza medicaginis* (Lib.) Sacc.). This disease was very severe but probably no more so than in previous years. The diseased leaves fall more readily than healthy leaves and the loss is quite heavy.

Other Leaf Spots due to various causes which have been recorded in previous reports were found occasionally but were of no importance.

Root Rots were found and were no doubt the cause of some troubles.

Ampelopsis

Leaf Spot (*Phyllosticta ampelopsidis* Ell. & Mart.). This disease was very prevalent, especially on the lower leaves of the plant. Other leaf spots were of no importance.

Apple

Crown Gall and Hairy Root (*Pseudomonas tumefaciens* S. & T.). Common on the apple and many other plants. Sometimes the very evident cause of weak and short-lived trees.

Black Rot (*Sphæropsis malorum* Pk.). Very common but no more severe than usual.

Bitter Rot (*Glomerella rufomaculans* (Berk.) S. & van S.). More severe than usual.

Blossom End Rot (*Alternaria sp.*). Very common but not serious.

Jonathan Spot (*Alternaria sp.*). Very abundant.

Fire Blight (*Bacillus amylovorus* (Burr.) DeToni). Less severe than for several years but very destructive in some few orchards.

Blotch (*Phyllosticta solitaria* E. & E.). More severe than usual. Most common on the Smith Cider.

Sooty Blotch (*Phyllachora pomigena* (Schu.) Sacc.). Common in neglected orchards.

Scab (*Venturia inequalis* (Cooke) Wint.). Common, especially in unsprayed orchards.

Rust (*Gymnosporangium juniperi-virginianæ* Schw.). Very severe in a few localities.

Pink Rot (*Cephalothecium roseum* Cda.). Common but of little importance.

Fruit Spot (*Cylindrosporium pomi* Brooks). Occasional.

Stippen (?). Very common.

Winter Injury. Very common.

Spray Injury. Very common when concentrated lime-sulfur 1 to 40 was used (page 571).

Water Core (?). Occasional.

Sun-Scald. Very common; due to exceptionally hot weather during July 4 and 5, 1919 (page 559).

Asparagus

Rust (*Puccinia asparagi* D. C.). Occasional.

Dwarfing. Short, weak shoots in the early spring. *Fusarium sp.* always present but we are not certain that it was the cause of the disease.

Asters

Yellows (cause unknown). This is a disease more or less prevalent every year.

Beans

ANTHRACNOSE (*Colletotrichum lindemuthianum* Sacc. & Magn.) (Bri. & Cav.). Prevalent throughout the state and destructive.

LEAF AND POD SPOTS (*Diaporthe phaseolorum* (C. & E.) Sacc.). Prevalent, especially in the southern part of the state, but not very destructive.

DOWNY MILDEW (*Phytophthora phaseoli* Thaxter). Very abundant and severe throughout the state.

ROOT ROT (*Rhizoctonia*). Very common.

RUST (*Uromyces appendiculatus* (Pers.) Lev.). Rare.

BACTERIAL BLIGHT (*Pseudomonas phaseoli* E. F. Smith). Occasional early in the season. Of no importance.

Beech

BURNING of the foliage early in the summer as a result of the low temperature in the early spring. Especially severe in the northern third of the state (page 570).

Beets

LEAF SPOT (*Cercospora beticola* Sacc.). Very abundant but not considered of any importance.

SCAB (*Actinomyces chromogens* Gast.). Very severe and destructive in one locality.

Blackberry

ANTHRACNOSE (*Gloeosporium venetum* Speg.). Common but of relatively little importance.

LEAF SPOT (*Septoria rubi* West.). Common but of very little importance.

RUST (*Gymnoconia peckiana* (Howe) Tranz.). Common and sometimes destructive.

(See Dewberry and Raspberry.)

Cabbage, Cauliflower and Kohlrabi

BLACK LEG (*Phona lingam* (Tode) Desmaz.). Prevalent in the southern part of the state and very severe in Camden County.

YELLOWS (*Fusarium conglutinans* Wollenw.). Common and widely distributed throughout the state but not severe.

BLACK ROT (*Pseudomonas campestris* (Pammel) Smith). Occasional.

CLUB ROOT (*Plasmodiophora brassicæ* Wor.). Occasional. Sometimes very destructive.

STEM ROT (*Rhizoctonia*). One record (page 559).

Cantaloupe

(See Muskmelon)

Carnation

RUST (*Uromyces caryophyllinus* (Schrank) Wint.). Common but not serious.

ROOT ROT (*Corticium vagum* B. & C. var. *solani* Burt.). Common but not serious.

Catalpa

LEAF SPOT (*Phyllosticta catalpæ* Ell. & Mart.). Common and sometimes the cause of heavy leaf-fall.

Cedar

RUST (*Gymnosporangium juniperi-virginianæ* Schw.). Very abundant in restricted localities throughout the state. Reported from Monmouth, Burlington and Cape May counties.

Celery

EARLY LEAF BLIGHT (*Cercospora apii* Fr.). Abundant in the celery-growing districts throughout the state.

LATE BLIGHT (*Septoria petroselini* Desm., var. *apii* Br. & Car.). Abundant in the celery-growing districts throughout the state.

ROOT ROT (*Sclerotinia libertiana* Fuckel). Occasional, sometimes severe.

CROWN AND HEART ROTS (*Bacterial*). Very severe in some localities (page 608).

Cherry

BROWN ROT (*Sclerotinia cinerea* (Bon) Shrot.). Abundant and very destructive.

LEAF SPOT (*Cylindrosporium padi* Karst.). Abundant and destructive (page 673).

Chestnut

BLIGHT (*Diaporthe parasitica* Murrell). Abundant.

Clover, Red

RUST (*Uromyces trifolii* (Hedw.) Lev.). Common but of no importance.

Corn

SMUT (*Ustilago zeae* (Beckm.) Urg.). Very common and in some cases serious.

WILT (*Fusarium* (?). Widely distributed throughout the state but most severe in Salem County (page 598).

WILT (*Pseudomonas stewarti* E. Smith). Occasional in the northern part of the state. Of no importance.

RUST (*Puccinia sorghii* Schw.). Occasional but of no importance.

LEAF BLOTCH (*Helminthosporium inconspicuum* C. & E.). Common.

Cowpea

LEAF SPOT (*Cercospora dolichii* E. & E.). Common.

Cranberry

Scald (*Guignardia vaccinii* Shear.). Widely distributed and very abundant in the cranberry bogs of the state.

Rot (*Acanthorhynchus vaccinii* Shear.). More or less common.

Anthracnose (*Glomerella rufomaculans vaccinii* Shear.). *Gloeosporium* stage common.

Cucumbers

Leaf Spot (*Macrosporium cucumerinum* C. & E.). Common and destructive.

Downy Mildew (*Plasmopara cubensis* (B. & C.) Humphrey). Common and destructive.

Wilt (*Bacillus tracheiphilus* Edw. Smith). Very common.

Stem Rot (*Sclerotinia libertiana* Fckl.). Occasionally found in the field. Probably due to the wet season.

Currant

Anthracnose (*Gloeosporium ribis* (Lib.) M. & D.). Very common.

Leaf Spot (*Septoria ribis* Desm.). Common.

Cane Blight (*Botryosphæria ribis* G. & D.). Common and very destructive.

Rust (*Cronartium ribicola* Kleb.), Reported from two localities (page 560).

Dewberry

Anthracnose (*Gloeosporium venetum* Speg.). Common and sometimes severe.

Double Blossom (*Fusarium rubi* Wint.). Abundant and sometimes injurious.

Rust (*Gymnoconia peckiana* (Howe) Franz.). Common and sometimes destructive.

Leaf Spot (*Septoria rubi* West.). Very abundant but of little importance.

Eggplant

Leaf Blight (*Phomopsis vexans* (Sacc. & Syd.) Harter). Abundant and in some cases destructive.

Wilt (*Verticillium albo-atrum* R. & B.). Common and destructive throughout the state.

Gooseberry

Antrcacnose (*Pseudopeziza ribis* Kleb.). *Gloeosporium* stage common.

Leaf Spot (*Septoria ribis* Desm.). Common.

Grape

Black Rot (*Guignardia bidwellii* (Ell.) V. & R.). Abundant and severe.

Downy Mildew (*Plasmopara viticola* (B. & C.) D. T.). Common but not serious.

Necrosis (*Fusicoccum viticolum* Reddick). Rare.

Hollyhock

Rust (*Puccinia malvacearum* Mont.). Very common.

Horse Chestnut

Leaf Spot (*Guignardia æsculi* Stewart). Very common.

Horse-Radish

Rot Rot (*Bacterial*). Very common and very destructive in one locality (page 610).

Root Rot (*Thielavia basicola* (B. & Br.) Zoph.). Very common in one locality (page 610).

Lettuce

Drop (*Sclerotinia libertiana* Fckl.). Common and sometimes destructive.

Rots (*Bacterium marginale* Brown and *B. vitians*). Reported from one locality.

Lilac

Mildew (*Microsphæra alni* (Walls.) Wint.). Very common.

Leaf Spot (*Phyllosticta halstedii* Ell.). Common.

Maple

Tar Spot (*Rhytisma acerinum* (Pers). Fr.). Occasional.

Leaf Scald (page 570).

Muskmelon

Wilt (*Bacillus tracheiphilus* (E. Smith). Common and sometimes destructive.

Downy Mildew (*Plasmopara cubensis* (B. & C.) Humphrey). Common and sometimes severe.

Leaf Mould (*Alternaria brassicæ* (Berk.) Sacc. var. *nigrescens* Pegl.). Common and severe.

Oak

Anthracnose (*Gnomonia veneta* (Sacc. & Speg.) Kleb.). Common.

Leaf Curl (*Taphrina cærulescens* (Mont. & Desm.) Tul.). Common and the subject of a number of inquiries.

Oats

SMUT (*Ustilago levis* (K. & S.) Magnus). Common.
SMUT (*Ustilago avenæ* (Pers.) Jens.). Common.
RUST (*Puccinia coronata* Cda.). Common.

Okra

WILT (*Verticillium albo-atrum* R. & B.). Abundant in one locality.

Pea

LEAF SPOT (*Ascocchyta pisi* Lib.). Occasional.
ROOT ROT (*Fusarium sp.*). Very abundant and very destructive. Heaviest losses in Burlington County (page 558).

Peach

BROWN ROT (*Sclerotinia cinerea* (Bon.) Schrot.). Abundant and destructive (page 572).
SCAB (*Cladosporium carpophilum* Thüm.). Abundant in unsprayed orchards. More destructive to foliage than usual (page 572).
LEAF CURL (*Exoascus deformans* (Berk.) Fckl.). Abundant in orchards that have not been properly sprayed.
SHOT HOLE (*Bacterium pruni* E. Smith). Abundant in some localities.
YELLOWS. Common.
LITTLE PEACH. Common.
CROWN GALL (*Pseudomonas tumefaciens* S. & T.). Common.
WINTER INJURY. In some cases severe and dating back to 1917-18.

Pear

FIRE BLIGHT (*Bacillus amylovorus* (Burr.) De Toni.). Common throughout the state and severe in a few orchards.
LEAF AND FRUIT SPOT (*Fabrea maculata* Lev.). Very abundant and very destructive in some orchards, especially in the southern part of the state.
LEAF SPOT (*Septoria pyricola* Desm.). Abundant.
BROWN BLOTCH (cause undetermined). Common.
SCAB (*Venturia pyrina* Aderh.). Common where the orchards have been neglected.

Pepper

ANTHRACNOSE (*Colletotrichum nigrum* E. & H.). Common.
ROT (*Macrosporium sp.*). Common on fruits, especially those that have been sunburned.
MOSAIC. Common but apparently of little importance.
SUN SCALD. Common and followed by fruit rots.
LEAF FALL (cause unknown). Cause of heavy losses.

Pine

Blister Rust of white pine (page 560).
Die-Back (*Diplodia sp.*). Very destructive on Austrian pine.

Plum

Black Knot (*Plowrightia morbosa* (Schw.) Thüm.). Common throughout the state.
Brown Rot (*Sclerotinia cinerea* (Bon.) Wor.). Common throughout the state and destructive.

Poplar

Leaf Spot (*Marsonia populi* (Lib.) Sacc.). Common.
Canker (*Dothichiza populae* S. & B.). Occasional and of some importance.

Potato

Brown Stem (*Rhizoctonia*). Common but not as destructive as in previous years.
Black Leg (*Bacillus phytopthorus* Appel). Rare.
Scab (*Actimonyces chromogenus* Gast.). Much more abundant than usual (page 587).
Early Blight (*Alternaria solani* (E. & M.) S. & G.). Abundant throughout the state (page 577).
Late Blight (*Phytophthora infestans* DeBarry). Very abundant and very destructive (page 577).
Mosaic. Very severe in some fields of Giants.
Leaf Roll. Rare; not found to exceed 2 per cent in any case.
Tip Burn. Common but less than usual.
Arsenical Poisoning. Common and usually due to carelessness in application.
Spindling Sprouts. Common. Probably due to several causes.

Quince

Black Rot (*Sphaeropsis malorum* Pk.). Very abundant and very severe.
Fire Blight (*Bacillus amylovorus* (Burr.) De Toni). Common.
Leaf and Fruit Spot (*Fabrea maculata* (Lev.) Atk.). Abundant and very severe.
Rust (*Rostellia anrentiana* Pk.). Occasional.

Raspberry

Anthracnose (*Gloeosporium venetum* Speg.), Abundant and destructive.
Leaf Spot (*Septoria rubi* West.). Abundant but of little importance.
Cane Blight (*Coniothyrium fuckelii* Sacc.). Common and sometimes destructive.
Crown Gall (*Pseudomonas tumefaciens* S. & T.). Abundant and destructive.

Rose

ANTHRACNOSE (*Gloeosporium rosae* Hals.). Common but not serious.
LEAF BLOTCH (*Actinonema rosae* (Lib.) Fr.). Common and very severe in greenhouses.
LEAF SPOT (*Phyllosticta rosicola* Massal.). Abundant and sometimes confused with leaf blotch.
CANE BLIGHT (*Coniothyrium fuckelii* Sacc.). Common and sometimes serious.
POWDERY MILDEW (*Sphaerotheca pannosa* (Wallr.) Lev.). Common and frequently very injurious.
CROWN GALL (*Pseudomonas tumefaciens* S. & T.). Frequent and sometimes serious.

Spinach

MOSAIC. Serious. Complicated with attacks of plant lice.

Strawberry

LEAF SPOT (*Mycosphaerella fragariae* (Tul.) Lidau). Common.
LEAF SPOT (*Ramularia tulasnei* Sacc.). Common.
POWDERY MILDEW (*Oidium fragariæ* Harz.). Occasional.
WINTER INJURY. Occasional.

Sunflower

RUST (*Puccinia helianthii* Schw.). Occasional.

Sweet Potato

BLACK ROT (*Sphaeronema fimbriatum* (E. & H.) Sacc.). Abundant and the cause of heavy losses (page 557).
STEM ROT or YELLOW ROT (*Fusarium batatatis* Wollen. and *F. Hyperoxysporum*). Abundant and the cause of heavy losses (page 557).
SCURF (*Monilochaetes infuscans* E. & H.). Very common.
ROTS (*Rhizopus nigricans* Ehr., *Diaporthe batatatis* H. & F., *Scleroticum bataticola* Tamb., *Tricoderma koenigii* and *Penicillium* sp.). Very abundant, especially in storage.
POX (*Cytospora batata*). Occasional.

Sycamore

ANTHRACNOSE (*Gnomonia veneta* (S. & S.) Kleb.). Very common. Sometimes destructive in nurseries.

Tomatoes

LEAF BLIGHT (*Septoria lycopersici* Speg.). Abundant and very destructive
FRUIT ROT (*Macrosporium solani* E. & M.). Common and very destructive.

Anthracnose (*Colletotrichum phomoides* (Sacc.) Chester). Abundant and very destructive.

Stem Blight or Wilt (*Fusarium lycopersici* Sacc.). Abundant in one locality.

Stem Cankers (*Rhizoctonia*). Abundant in lower part of the state (page 559).

Mosaic. Abundant.

Leaf Mold (*Cladosporium fulvum* Che.). Common in greenhouses and very severe.

Late Blight (*Phytophthora infestans* DeBary). Severe in one locality.

Sun Burn. Severe at times. Followed by fruit rots.

Walnut

Leaf Spot (*Marsonia juglandis* (Lib.) Sacc.). Abundant and cause of early fall of foliage. Subject of many inquiries.

Bacterial Spot of Leaf and Fruit (*Pseudomonas juglandis* Pierce). Abundant on English walnuts and the cause of many inquiries.

Watermelons

Anthracnose (*Colletotrichum lagenarium* (Passe.) E. & H.). Very abundant.

Stem Rot (*Sclerotinia libertiana*). Common in the fields. Probably the result of wet weather.

Wheat

Rust (*Puccinia coronata* Cda.). Common.
Rust (*Puccinia rubigovera* (De C.) Wint.). Common.
Rust (*Puccinia triticina* Erb.). Common.
Smut (*Tilletia foetens* (B. & C.) Trel.). Common.
Smut (*Tilletia tritici* (Bei.) Wint.). Common.
Smut (*Ustilago tritici* (Pers.) Jens.). Common.
Mold (*Cladosporium herbarium* (Pers.) Lk.). Abundant.
Scab (*Gibberella saubinetti* (Mont.) Sacc.). Very common and destructive.

Forest and Shade Trees

Leaf Fall (pages 570-571).

FALLING FOLIAGE

Mel. T. Cook

The spring and summer of 1919 were notable in New Jersey because of the enormous amount of falling foliage and the susceptibility of many trees to spray injury. In fact, spray mixtures which had been very generally recommended and used in the past resulted in more or less injury to both foliage and fruit.

The first complaints coming to the Experiment Station was concerning the dying and falling of foliage of the beech and the apple.

All of the complaints concerning the beech and most of those concerning the apple were from the northern third of the state.

The writer visited the Essex County parks, and some of the private estates, and also examined many specimens which were submitted to him. The beech leaves showed a peculiar burning or drying along the margins and frequently between the veins. In severe cases the leaves fell in great numbers. Many of the trees suffered a very severe attack, some of them losing great quantities of foliage while others showed very little burning.

A careful study of the conditions convinced the writer that the trouble was entirely due to a period of low temperature soon after the leaf buds opened and before they were fully developed. At this particular time the protoplasmic activity was high and the cuticle not fully developed. Therefore, the leaves continued to grow to some extent and the dying of the injured cells was a slow process. The effects of this low temperature extended over a period of about six weeks. The variation in the amount of injury was dependent on the advancement of the leaves at the time of the low temperature, to the location of the trees and to the exposure.

The dying of apple leaves was not so definite as the dying of the beech leaves but practically all of the injured leaves fell. Repeated examinations failed to reveal a fungus or any cause of the trouble other than the cold weather. Only the leaves that were coming out at the time of this low temperature showed injury. The latter leaves were not injured.

These conditions should not be confused with sun scald and drought injuries which are more or less common on many trees later in the season.

Weak Trees

Trees, more especially the peach, which were weakened as a result of winter injury in 1917-18, by borers, or for want of food lost considerable foliage during the latter part of June and first part of July.

Spray Injury

Spray injury was more frequent than in past years; many mixtures causing injuries which had not given trouble in past years. Among the most important were summer-strength lime-sulfur and atomic sulfur. Arsenical burnings were also quite frequent. The self-boiled lime-sulfur did not cause burnings and gave good control in both peach and apple orchards.

Paris Green Injury

The falling of foliage in some orchards was very readily traced to paris green dust which had drifted in from the adjoining potato

fields. In these cases the injury was always most severe on the rows next to the potato field and less severe on the succeeding rows.

Brown Rot of the Peach

During the blooming period of the peach in 1919 there was an exceptionally severe outbreak of the twig and blossom blight caused by the brown rot organism (*S. cinerea*). This outbreak was most severe in the vicinity of Vineland and Bridgeton and was of very little importance in the northern part of the state. This was by far the most severe outbreak of this disease that the writer has ever observed. It was not abundant on the young shoots but destroyed great quantities of blossoms. In the majority of cases a sufficient number of blossoms remained for a normal crop, the problem being to protect those that did remain from curculio and other pests.

Many growers sprayed with self-boiled lime-sulfur or atomic sulfur at this time. It is doubtful if this checked the disease on the blossoms, although it did prevent the spread to the new wood, as will be explained later.

The blossom blight form did not persist, but was followed by a spreading into the wood and the formation of cankers in most cases where blossoms were killed. These cankers produced an abundance of gum which in some cases continued to flow until some time in August.

The blossom blight was followed by the formation of cankers at the nodes on the new growth, always beginning with basal node and gradually working toward the tip and rarely missing a node. The first evidence of the canker is the dying of the bud, followed by the falling of the leaf and then the formation of the canker. The older cankers at the base of the shoots sometimes form a girdle and cause the death of the entire new growth. In many cases cankers were formed at every node for fully two-thirds the new growth. This is one of the most important causes of the falling of the foliage during July. In some orchards 75 per cent of the new buds were killed. In the well-sprayed orchards very few cankers were formed on the new growth.

Peach Scab

Peach scab came into prominence on the fruit in July and became quite common in well-sprayed orchards in the latter part of the month. In the early part of July this disease also appeared on the leaves and increased in abundance. The symptoms were first a reddening of the foliage followed by shot hole and then by falling. This was one of the most important causes of the falling of the foliage.

Cherry Leaf Spot

This disease was very abundant and by the latter part of July many trees were almost completely defoliated.

It can be controlled by two sprayings with self-boiled lime-sulfur; first with the shuck-fall (add an arsenical), and second after picking the fruit. A third spray would be advantageous.

FIELD STUDIES ON POTATO DISEASES

Mel. T. Cook

During the past eight years the writer has been giving considerable time to a study of the diseases of potatoes. The most important diseases considered during this time are: (1) black leg, (2) powdery scab, (3) common scab, (4) *Rhizoctonia,* (5) early blight, (6) late blight, (7) dry rot, (8) weather injury, (9) mosaic and (10) leaf roll. A brief resumé of the work will be given in this paper.

(1) Black Leg is a bacterial disease (*Bacillus phytopthorus* Appel) which was very severe and destructive a few years ago, sometimes causing a loss of 15 per cent. This disease is very rare at the present time. It is very easily recognized and the certification work is no doubt largely responsible for its removal from the growing crops in the northern seed-producing districts. Diseased plants die very early under New Jersey conditions and rarely produce seed tubers; therefore, the growing of late-crop seed tends to eliminate it.

(2) Powdery Scab, which is said to be a very serious disease in Europe, was introduced into Canada, Maine and New York a few years ago. Planting diseased seed in experiments under our supervision did not produce the disease on the new crop. This was corroborated by experiments in other states.

(3) Common Scab is a well-known disease which was the subject of three years' work by Dr. H. Clay Lint, formerly of this department. His work is recorded in the Annual Reports for 1914, 1915 and 1916, and in Circular 95. Work on this disease was resumed in 1919 by Dr. W. H. Martin (pages 587-598).

(4) Scurf or Rhizoctonia is a very injurious disease which varies in severity from year to year. It is very generally known in New Jersey by the name of "brown stem." The black sclerotia are visible on the tubers which may be smooth and apparently normal in every way, or may be small and irregular in shape, or, in extreme cases, may have very much the same general appearance as common scab. The organism can be carried on the seed and will also persist in the soil and will attack many other plants. Our experimental work[2] shows

[2] Part of the material used in these experiments was collected in New Jersey and part sent us by Dr. W. J. Morse, of the Maine Agricultural Experiment Station.

that the amount of infection on the seed tubers is no index of the severity of the disease in the field. The severity of the disease on the growing crop varies with the character of the soil, and probably with the temperature and the moisture.

The results of an experiment on seed treatment for the control of this disease are given in table 1.

TABLE 1

Results of Seed Treatment to Control Disease—Experiment I

Row No.	Condition	Treatment	Condition of crop	Total yield, lbs.	Yield per row, lbs.	Firsts per cent	Seconds per cent
6, 7, 8, 9	Sclerotia abundant	Untreated	Very few Sclerotia	90.0	22.5	50.0	29.9
10, 11	Sclerotia abundant	Corrosive Sublimate	Clean	101.3	50.6	83.3	13.9
12, 13	Sclerotia abundant	Formaldehyde	Clean	70.0	35.0	71.0	20.0
22, 23	Sclerotia abundant Deep pits	Untreated	Few Sclerotia	75.6	37.8	77.0	16.3

The results of a second experiment are given in table 2.

The results of these experiments indicate that corrosive sublimate gives much better results than formaldehyde.

(5) Early Blight (*Macrosporium solani* (E. & M.) J. & G.) is a very common disease on both potatoes and tomatoes. The organism is both parasitic and saprophytic and is very frequently found growing on parts of plants injured by tip-burn, arsenical poisons or other factors. The disease can frequently be controlled by spraying with bordeaux mixture and can usually be delayed by this treatment.

(6) Late Blight (*Phytophthora infestans* DeBy) is one of the most important diseases of the potato in America. It attacks both the foliage and the tuber, causing the well-known mahogany rot on the latter. More or less of this disease comes into New Jersey on the northern seed every year but rarely develops on the growing

plants. In 1918 there was an outbreak throughout Mercer and Monmouth counties, and the southern half of Middlesex, but the losses were not serious. In 1919 there was a very severe outbreak throughout practically the entire state beginning the latter part of July, and gradually becoming more and more severe throughout the growing season. The losses in the early or main crop due to this disease were very slight, but the losses in the late crop grown principally for seed were very heavy. The losses in the first crop during the

TABLE 2

Results of Seed Treatment to Control Disease—Experiment II

Plots	Hill	Character of seed	Treatment	Number of Firsts	Weight of Firsts	Number of Seconds	Weight of Seconds	Total
					lbs.		lbs.	lbs.
4	1-38	Sclerotia abundant many deep pits	None	109	36.67	237	16.04	51.71
5	1-38		Corrosive Sublimate	144	49.7	138	11.29	60.99
6	1-38		Corrosive Sublimate	163	56.66	156	13.87	70.53
7	1-38		None	120	40	247	22.91	66.91
8	1-38		Formaldehyde	100	33.41	216	17.83	51.24
9	1-38		Formaldehyde	147	48.63	208	14.01	62.64
10	1-38		None	116	40.49	310	19.57	60.06

last few days of July and the early part of August were complicated by the losses due to bacterial rots. Undoubtedly the greater part of these early losses were due to the bacterial rot. The Federal market inspectors found late blight rot in some of the early shipments from New Jersey, but were misled as to the amount due to this cause and the amount due to bacteria. The losses due to bacteria were very heavy in many fields in which there was no late blight. The loss due to bacteria was 90 per cent in some of the experimental plots on the Experiment Station farm in which there was no late blight. The results of the potato spraying experiments by Dr. W. H. Martin are given on pages 577-587.

(7) Dry Rot (*Fusarium oxysporum* Schlt.) is to be found every year and occasionally causes losses, but cannot be considered as one of our most important diseases. The writer has made numerous tests by planting the sound parts of potatoes partly rotted by this and other organisms. In the majority of cases the plants were weak as compared with those grown from sound tubers.

(8) Weather Injuries are more or less common. One of the most important forms of weather injury is "tip-burn." It is most severe during hot weather following a wet season.

(9) Mosaic is one of the most severe diseases on the American Giant. It is also very severe on Green Mountains and Bliss Triumphs, but these varieties are not used so abundantly in this state. Experimental tests covering a period of 5 years reveal the following facts: (1) The disease is transmitted in the tubers; (2) it reduces the yield, and (3) it increases in severity from year to year.

A few of the characteristic results of experimental work on this disease are discussed below.

Green Mountain potatoes from Maine, sent to us by Dr. W. A. Orton, of the United States Department of Agriculture, gave the following results in 1916:

Plot	Seed	Crop	Firsts	Seconds	Total yield per acre
			per cent	per cent	bushels
1	Healthy	Fine	86.10	12.80	429
2	Mosaic	52.6 per cent Mosaic	60.88	13.12	329
3	Mosaic	Severe Mosaic	66.27	33.72	169+
4	Mosaic	Mosaic	74.29	24.27	335

A study of this table shows that plants affected with Mosaic gave a lower yield than the healthy plants. The disease is not so easily detected on the Green Mountains as on the American Giants. The more prominent the disease on the foliage, the less is the yield.

The 1917 experiments were conducted with Bliss Triumphs. The seed was obtained from Maine through the United States Bureau of Plant Industry and the results are as follows:

Plot	Character	Yield per acre
1	Mosaic	73 bushels
2	Healthy	98 bushels

In 1919 tests were made with American Giants, using seed selected by the writer from the New Jersey 1918 late crop. The results were as follows:

Plot	Firsts	Seconds	Yield per acre firsts and seconds	Character
	per cent	per cent	bushels	
1	71.87	28.12	117	Mosaic
2	76.54	23.45	89	Mosaic
3	83.72	16.28	157	Healthy
4	69.80	30.2	300	

(10) Leaf Roll of the Irish Cobblers is a very serious disease which varies greatly from year to year. Repeated experiments have demonstrated that it reduces the yield. The results in 1919 with Maine seed furnished by the United States Bureau of Plant Industry, Laboratory for Cotton, Truck and Forage-Crop Disease Investigations, gave the following results:

Plot	Character	Firsts	Seconds	Yield per acre firsts and seconds
		per cent	per cent	bushels
1	Leaf roll	25.78	74.22	57
2	Leaf roll	43.9	56.1	69
3	Healthy	53.0	47.10	132
4	Healthy	60.8	39.2	144

REPORT OF POTATO SPRAYING TESTS

Wm. H. Martin

Cooperative potato spraying experiments were conducted by the department of plant pathology during the summer of 1919. The general plans followed in these experiments were similar to those

followed in experiments by the department during the past seven years.

In the period over which this work was carried on, twelve spraying experiments have been conducted with main-crop Cobblers; of these, eight gave positive results and four negative. The increase from spraying has not been marked, however. The average yield of the plots sprayed with bordeaux-arsenate of lead was 266.6 bushels, while the average for plots sprayed with arsenate of lead was 261.0 bushels. Spraying experiments with late-crop Cobblers were conducted three years. This crop is planted about August first and is used for seed the following year. On account of the late planting date, the crop grows under conditions similar to those of the northern potato-growing sections. The average yield of the sprayed plots was 209.3 bushels per acre, and the yield of the check plots was 199.0 bushels. Experiments with the American Giant variety were conducted for three years. The average yield for the plots sprayed with bordeaux was 354.6 bushels, and the yield of the check plots sprayed with arsenate of lead was 354.3 bushels per acre.

In the period over which these experiments were conducted the only foliage diseases which appeared were tip-burn and early blight. Considerable late blight was reported in various parts of the state in 1918, but none appeared in the fields in which the spraying experiments were conducted. The absence of late blight may account for the fact that only slight increases resulted from spraying.

This year two experiments were conducted with the main crop, one with Irish Cobblers and the other with American Giants. There was no late blight in the fields in which this work was done. One experiment was conducted with the late-planted Cobblers. This year there was a serious outbreak of late blight on this crop, the first time the disease has been reported from the section in which this work was done since 1897. At that time Dr. Halsted reported that scarcely a leaf escaped attack. As a result of the presence of this fungus in the field marked results were obtained. The vines on the sprayed plots were green for some time after the unsprayed vines were dead. The difference between the plots is clearly shown in plate 5.

Spraying Test in Cooperation with J. Harry Kandle, Elmer, N. J.

The soil on which this test was conducted is a Sassafras loam to sandy loam in excellent condition and well adapted to potatoes.

The field was planted with home-grown Irish Cobblers. One ton of a 4-8-3 fertilizer per acre was applied at the time of planting. The field was divided into 10 plots each 8 rows wide. To eliminate differences that might arise from soil variation a check plot was alternated with every two treated plots. Each treatment with the check

was repeated three times. The check plots were sprayed with arsenate of lead at the rate of 3 pounds to 50 gallons of water.

The following spray mixtures were used: home-made bordeaux mixture of the standard 5-5-50 formula and a zinc bordeaux furnished by the General Chemical Company, of New York. The proprietary mixture was used at the rate of 16½ pounds to 100 gallons of water, this being equivalent in the amount of metallic copper to the home-made mixture.

The sprays were applied with a traction sprayer that developed 150 pounds pressure. This machine was entirely satisfactory and it is questionable if higher pressure would give better results. For the first application two nozzles were used to the row, for subsequent ones an additional nozzle was used. One nozzle was pointed downward while the other two were directed inward so that the lower leaf-surfaces were covered with a film of the mixture.

Five spray applications were made on each of the different treatments. The first application was made May 31, when the plants were about 6 inches high. At the time of the second application, June 10, the plants were 18 inches high and were still free from disease. The third and fourth applications were made June 17 and 27, respectively. On the latter date, there was considerable early blight and tip-burn on the check plots with smaller amounts on the sprayed plots. The last application was made July 7; at that time, there was a decided contrast between the sprayed and the unsprayed plots. The plots were free from potato beetles at all times during the summer. Large numbers of flea beetles were present during the early summer and the copper mixtures did not appear to repel them to any marked extent.

On July 22 an examination of all the plots was made to determine the per cent of dead leaves on the different plots. It was impossible to do this for every plant, so observations were made on every tenth plant in the central row of each plot.

In table 1 is given the per cent of dead leaves for each plot as well as the average for each treatment.

The dying of the leaves may be ascribed for the most part to a heavy infestation of early blight and to tip-burn. It will be noticed that the plots sprayed with the commercial mixture had fewer dead leaves than those sprayed with home-mixed bordeaux. In this connection, it is interesting to note that two weeks before these observations were made, the plots sprayed with the home-made mixture had fewer dead leaves than the other plots. The marked differences in the number of dead leaves are due to the control of early blight and tip-burn. In a spraying experiment conducted on this field in 1915 by Dr. H. C. Lint, a similar contrast was obtained. From the time the differences were noticed until the potatoes were dug there was dry weather. This may account for the fact that there was no increase in yield at that time. This year, after the contrast between the check and the sprayed plots had appeared there was a week

TABLE 1

Per Cent of Dead Leaves on Each Plot and the Average for Each Treatment

Treatment	Dead Leaves			
	Series 1	Series 2	Series 3	Average
	per cent	per cent	per cent	per cent
Check	98	98	90	89
Bordeaux 5-5-50	45	45	40	44
Zinc-bordeaux	40	20	20	27

TABLE 2

Arrangement of Plots and Yield Per Acre in the Spraying Experiment With Main-Crop Cobblers

	Total Yield per acre			Yield of Firsts per acre			Yield of Seconds per acre		
	All plots	Calculated check		All plots	Calculated check	Difference due to spray	All plots	Calculated check	Difference due to spray
	bu.	bu.	per cent	bu.	bu.	bu.	bu.	bu.	bu.
Check	202.9			176.1			26.8		
Bordeaux mixture	261.3	201.8	77.4	227.0	175.9	51.1	34.3	26.1	8.2
Zinc-bordeaux	253.5	200.9	79.2	212.6	175.6	37.0	40.9	25.4	15.5
Check	200.0			175.3			24.7		
Bordeaux mixture	270.2	212.5	78.6	239.1	183.0	56.1	31.1	29.5	1.6
Zinc-bordeaux	275.1	225.0	81.7	232.2	190.7	41.5	42.9	34.3	8.6
Check	237.5			198.6			39.0		
Bordeaux mixture	264.6	232.9	88.0	232.5	196.2	36.3	32.1	36.6	—4.5
Zinc-bordeaux	277.3	228.2	82.2	241.3	193.9	47.4	36.4	34.3	2.1
Check	223.6			191.6			32.0		
Average	Bordeaux		+18.7	Bordeaux		+47.8	Bordeaux		+1.8
	Zinc-bordeaux		+19.3	Zinc-bordeaux		+41.9	Zinc-bordeaux		+8.7

of wet weather. As a result of this the sprayed plants, being still green, continued their growth. This may explain the fact that an increase in yield followed the spray applications this year.

The arrangement of the plots and the yield per acre for each plot are given in table 2.

To obtain a more accurate measure of the influence of the different spray treatments on yield the "calculated yield" for each sprayed plot has been computed on the basis of the yields from the adjoining check plots. The difference between the calculated yield of a plot and the actual yield has been taken as the difference due to the spray treatment.

It will be seen from the table that there was very little difference between the yields from the plots treated with the two spray mixtures. On a basis of total yields, the average increase over the check for the home-made bordeaux mixture was 49.6 bushels, while the commercial mixture gave an increase of 50.6 bushels over the adjoining checks.

Spraying Test in Cooperation with Theron McCampbell, Holmdel, N. J.

Conflicting results have been obtained in the past from spraying experiments with the American Giant variety. Of the three experiments, two gave an increase of 3 and 8 bushels per acre, respectively, while the third gave a decrease of 10 bushels per acre. This year an experiment with this variety was conducted in one of the best potato growing sections of the state. The field in which the work was done was planted with the Irish Cobbler variety in 1918. The vines did not make their growth and a poor crop resulted. Numerous reports have come to the Experiment Station of the failure of potatoes following alfalfa. In this connection, it is interesting to consider the crop history of this field for the past seven years:

1913-17—Alfalfa, 15 crops removed.
1918—5 carloads of New York horse manure added in early winter.
1918—Planted in Cobblers. Vines stunted, only about half a crop. After the crop was dug 500 pounds of 4-8-0 fertilizer per acre was broadcasted, and the field planted in wheat.
1919—500 pounds steamed bone added before the wheat was turned under. American Giant variety planted; 1500 pounds of a 4-8-3 fertilizer applied at time of planting.

This year there was a good stand and the vines made a good growth. It is doubtful if the soil condition had any marked influence on the results obtained from the spraying experiment.

The spray mixtures used were calcium arsenate, arsenate of lead, paris green and bordeaux mixture. The arsenate of lead was used

at the rate of 3 pounds of the powder to 50 gallons of water; the other insecticides were used in such proportions as to give equivalent amounts of metallic arsenic in every case. The insecticides were added in the experiment to determine the relative efficiency of the various sources of arsenic. This phase of the work was under the direction of the department of entomology of the station. The bordeaux mixture used was of the 5-5-50 formula, containing 3 pounds of arsenate of lead. The sprays were applied with a power sprayer that developed 250 pounds' pressure. As the field was laid out there were 25 plots, each 8 rows wide. A check plot alternated with each two treated plots. The check plots, nine in all, were sprayed with arsenate of lead. The paris green and calcium arsenate plots were repeated four times and the bordeaux plots eight times.

Table 3 records the dates on which the spray applications were made, as well as the insects and diseases present in the field at the time.

TABLE 3

Conditions of the Spray Applications

Plots	Date of Application	Insects Present	Diseases Present
5-11-17-23	May 16	Flea beetles	No foliage disease
All plots	May 27	Flea beetles	No foliage disease
All plots	June 5	Flea beetles	Some tip-burn
All plots	June 12	None	Tip-burn and early blight
All plots	June 20	None	Tip-burn and early blight

Prior to June 20 there were no noticeable differences between the different plots. After that date, the plots sprayed with paris green became heavily infested with early blight while the remaining plots were only slightly infested. Late in the summer the plots sprayed with arsenate of lead were decidedly better than those sprayed with bordeaux mixture. At first thought, this would appear to be due to the use of an improperly prepared bordeaux mixture. This explanation will not suffice, however, since plants under fertilizer and variety tests in adjoining fields were sprayed with the same mixture and on the sames dates. These vines remained green for some time after unsprayed plants in neighboring fields had begun to die. The fact that the plots sprayed with arsenate of lead were greener than the bordeaux plots would indicate that the former may have acted in some way to stimulate the vines. No definite statement to this effect can be made, however.

TABLE 4

Arrangement of Plots and Yields Per Acre in the Spraying Experiment With the American Giant Variety.

Section 1					Section 2					Section 3				
Treatment	All Plots	Calculated	Check	Difference	Treatment	All Plots	Calculated	Check	Difference	Treatment	All Plots	Calculated	Check	Difference
	bu.	bu.	bu.	per cent		bu.	bu.	bu.	per cent		bu.	bu.	bu.	per cent
Check	245.0				Check	273.1				Check	286.0			
Bordeaux	188.3	230	123	—41.7	Bordeaux	229.1	264.0	115	—34.9	Bordeaux	265.1	285.0	107	—19.1
Calcium arsenate	188.3	215	114	—26.7	Calcium arsenate	207.3	255.1	123	—47.8	Calcium arsenate	207.3	284.1	137	—76.8
Check	200.0				Check	246.2				Check	283.2			
Bordeaux	193.6	208.8	107	—15.2	Bordeaux	253.3	260.1	102	—6.8	Bordeaux	271.3	292.1	107	—20.8
Paris green	196.6	216.8	110	—20.2	Paris green	245.4	274.0	111	—28.6	Paris green	263.5	301.0	114	—37.5
Check	226.5				Check	287.8				Check	309.0			
Bordeaux	188.3	226.5	120	—38.2	Bordeaux	220.0	284.5	129	—64.5	Bordeaux	237.9	303.6	127	—65.7
Calcium arsenate	233.3	226.5	97	6.8	Calcium arsenate	266.6	281.2	105	—14.6	Calcium arsenate	260.5	297.3	114	—36.8
Check	226.5				Check	277.9				Check	291.0			

At harvesting time, most of the plots in the experiment were dug before the yields could be taken. As a result of this the yields on only ten plots were obtained. Each of these plots was divided into three sections in harvesting. In this way, three or more duplications of each treatment were secured. The arrangement of the plots together with the yields per acre are given in table 4.

It will be seen from the table that the yields of the bordeaux plots are lower than those of the arsenate of lead plots. The difference between the yields of the bordeaux, calcium-arsenate and paris-green plots is so small as to be well within experimental error. The average yields of the plots receiving the various treatments are summarized below:

Arsenate of lead	262.8 bushels per acre
Paris green	235.1 bushels per acre
Bordeaux mixture	228.3 bushels per acre
Calcium arsenate	227.2 bushels per acre

In connection with the tests of the different spray mixtures the experiment was designed to determine the most efficient pressure of applying the sprays. As has been previously indicated, there were four duplications of each spray treatment; two of these were applied at 150 pounds' and two at 250 pounds' pressure. Since the yields were not obtained from all the plots the results were incomplete, but those secured are given in table 5.

TABLE 5

Effect of Applying Sprays at Different Pressures

Treatment	Pressure	
	150 lbs.	250 lbs.
	bu. per acre	bu. per acre
Bordeaux mixture	215.7	227.5
Arsenate of lead	258.9	266.5
Calcium arsenate	253.4	200.9
Paris green	235.1	.....

The plots sprayed with bordeaux mixture at 250 pounds' pressure gave an increase of 11.8 bushels over those sprayed with 150 pounds. The results obtained with the insecticides are contradictory and no conclusions can be drawn from the data at hand.

An effort was made to determine if any benefit would follow an early application of bordeaux mixture. Four plots were sprayed with bordeaux when the plants were 6 inches high, and four others were sprayed when the plants were from 2 to 4 inches high. This early application was made in an effort to control flea beetles. When the plants are of this size, it is difficult to reach the lower leaf surface; this may account for the fact that very little control resulted. The average yield of the plots that received the early application was 17.8 bushels less than the yield of the plots where the early application was not made. No differences were observed between these plots during the summer, so there is no reason to believe that the plants were injured by the early application.

The conflicting results obtained from spraying the American Giant variety this year are in accord with those obtained in the experiments previously conducted with this variety. It is possible that varietal differences may be an important factor in potato spraying experiments. This would appear probable in view of the fact that most of the experiments with Cobblers conducted in past years have given positive results. The American Giant variety makes a rapid growth, soon filling the rows, making it impossible to continue the spray applications late in the growing season. While the results obtained this summer would not indicate this to be the reason for the lack of success in spraying this variety, it might help to account for it.

Late-Crop Spraying Test in Cooperation with J. Harry Kandle, Elmer, N. J.

The soil on which this test was conducted is a Sassafras loam in good condition. The field was without irregularities. The variety Irish Cobbler was planted. One ton of a 4-8-3 fertilizer was applied per acre at the time of planting, August 6. The field was divided into 19 plots, each 4 rows wide. The arrangement of the plots was such that a check plot alternated with each sprayed plot. There were no insects of any kind present so that it was possible to leave the check plots unsprayed. The treated plots were sprayed with bordeaux mixture, the 5-5-50 formula being used.

Four spray applications were made. The first one, on September 12, was made when the plants were about 9 inches high; the delay in making the first application had no influence on the results, since there were no diseases present in the field at that time. At the time of the second application, September 19, there was a slight amount of early blight on the unsprayed plants. The third application was

made September 29. At this time, three plants infested with late blight were found in the check plots. At the time of the fourth application, October 9, 75 per cent of the leaves on the unsprayed plants were infested with late blight while there was only a trace on the sprayed plots.

A thorough examination of the field was made October 21, and at that time 3 per cent of the leaves on the sprayed plots were dead. The appearance of the check plots at this time was interesting. As has been stated, the plots were all 4 rows wide; in every case the plants in the two central rows of the check plots were dead. On the

TABLE 6

Arrangement of Plots and Yields per Acre of the Potato Spraying Test with Late-Crop Cobblers

Treatment	All Plots	Calculated Check	Difference
	bu.	bu.	bu.
1. Check	121.9	.....	....
2. Bordeaux	172.2	126.8	45.4
3. Check	131.8	.....	....
4. Bordeaux	190.1	126.2	63.9
5. Check	120.7	.....	....
6. Bordeaux	166.6	127.9	38.7
7. Check	135.1	.....	....
8. Bordeaux	185.0	138.0	47.0
9. Check	140.9	.....	....
10. Bordeaux	172.2	138.9	33.3
11. Check	136.9	.....	...
12. Bordeaux	196.2	138.9	57.3
13. Check	140.9	.....	....
14 Bordeaux	192.3	136.1	56.2
15. Check	134.7	.....	...
16. Bordeaux	195.1	135.8	59.3
17. Check	132.5	.....	....
18. Bordeaux	181.1	132.6	48.5
19. Check	131.9	.....	....

two outer rows, adjoining the sprayed plots, the inner half of the vines was dead while the side toward the sprayed plots was still green and vigorous. This was the result of some of the spray mixture reaching the outer side of the plants. In measuring the yields the outer rows of each plot were discarded.

The treatments of the various plots together with the yields per acre are given in table 6. The average yield of the check plots was 132.6 bushels per acre and of the sprayed plots 183.4 bushels, a difference of 50.8 bushels in favor of the spray treatment.

Spraying experiments with the late-planted crop have given increases every year, even in the absence of late blight. This crop is planted late so that the vines will still be green when killed by frost, thus insuring seed of high vitality. This year a large part of the crop in South Jersey was dead for several weeks before frost, as a result of the epidemic of late blight. In this crop the yield is secondary in importance, the vitality of the tuber for seed purposes being the primary consideration. In view of this fact, the benefits to be derived from spraying the late crop cannot be measured by an increase in yield alone. While it is doubtless true that the differences obtained would not be as marked every year as they were this year, it is probable that spraying would hold the vines for some time. This consideration alone would possibly warrant the adopting of the practice of spraying the late crop.

SEED TREATMENT FOR THE CONTROL OF POTATO SCAB

WM. H. MARTIN

Seed treatment for the control of potato scab has been recommended for a number of years but the practice has not been generaly adopted in the important potato producing areas of the state. In some instances the omission of seed treatment is due to the fact that failure resulted from previous attempts. Where this occurred, it was largely due to the fact that the treated seed was planted in scab-infested soil. Under these conditions seed treatment will no doubt be of some value but will not insure a clean crop. In a small number of cases, injury has followed seed treatment; very frequently this has been due to the improper treatments, such as treating after the sprouts are well developed, employing too strong a mixture or allowing the tubers to remain too long in the solution and treating after cutting.

The principal reason for the failure to adopt seed treatment lies in the fact that the practice consumes so much time. The present recommendation for seed treatment is to soak the tubers for 1½ hours, which makes it practically impossible to treat the seed fast enough to keep ahead of the planter. This is especially true where a large acreage is planted; to treat enough seed for fifty or more acres would require the entire time of two men for several weeks at a time when they would be needed for other work.

Since the length of the time period has deterred the growers from treating seed, experiments were conducted to determine if this could be reduced without loss of efficiency. In connection with this, tests were conducted with both formaldehyde and mercuric chloride (corrosive sublimate) to determine which would give the best control of scab. The formaldehyde solution used was made up at the rate of

1 pint of 40 per cent formalin to 30 gallons of water; the mercuric chloride at the rate of 4 ounces to 30 gallons of water. In every case the solutions were used for only one lot of potatoes, when they were renewed. This was done to insure that all the solutions be of the same strength for the different treatments. In all there were four treatments as follows: 1 hour, ½ hour, ¼ hour and sprinkled. For the first three treatments, the different lots of potatoes were placed in wooden containers and covered with the solution to be tested. They were so left for the desired time period, and then were removed and dried. The potatoes that were sprinkled were placed in a heap and covered with a burlap bag for 30 minutes.

The seed used was a vigorous strain of home-grown Irish Cobblers. To insure the presence of the scab organism, scabby seed was planted, tubers being selected that showed approximately the same amount of scab. In cutting the seed, care was taken to have the seed pieces the same size, in order to eliminate differences that might arise from the use of seed pieces of different weight.

TABLE 1

Effect of Seed Treatment on Germination

Formaldehyde Treatment	Stand	Mercuric chloride Treatment	Stand
	per cent		per cent
1 hr.	98.4	1 hr.	98.0
½ hr.	98.8	½ hr.	96.8
¼ hr.	98.4	¼ hr.	98.8
Sprinkled	96.3	Sprinkled	97.2
Check	91.5	Check	91.5

The soil on which the experiment was conducted is a Penn loam in good condition. Sixteen hundred pounds of a 4-8-3 fertilizer per acre was applied at the time of planting, April 22. The field was divided into 24 plots, each 69 feet long and two rows wide, approximately one-fiftieth acre. These plots were laid out so that a check plot was left between each two treated plots, making eight in all. Each of the treatments was repeated twice.

On June 2 a count was made of the number of plants up. The results of this count are recorded in table 1, which gives the averages for the different plots.

It will be seen from the table that the germination of the treated plots was practically the same. The average for the formaldehyde treatments was 97.9 per cent, and 97.7 per cent for those treated with mercuric chloride. The average for the check plots was 91.5 per cent. At the time of this observation, the plants on the treated plots were for the most part uniform in size while on the check plots some were up 6 inches and others had just appeared above the ground. The vines on the treated plots were larger throughout the early part of the summer than those on the untreated. As the season advanced this difference was not so marked.

TABLE 2

Effect on Yield and Scab Control of Treating Seed Tubers With Disinfectants

Treatment	Total Yield per Acre	Primes per Acre		Seconds per Acre		Unsalable Scabby per Acre		Scabby in Primes
	bu.	bu.	per cent	bu.	per cent	bu.	per cent	per cent
Formaldehyde 1 hour	147.4	134.7	91.3	8.2	5.6	4.5	3.0	18.4
Formaldehyde ½ hour	175.3	159.0	90.7	8.6	4.9	7.7	4.3	17.9
Formaldehyde ¼ hour	158.9	144.9	91.1	6.3	3.9	7.7	4.9	30.2
Formaldehyde sprinkled	146.4	130.9	89.4	8.2	5.7	7.3	4.8	29.9
Mercuric chloride.. 1 hour	178.6	159.0	89.2	11.9	6.5	7.7	4.2	17.2
Mercuric chloride.. ½ hour	148.3	131.5	88.6	8.2	5.6	8.6	5.7	26.6
Mercuric chloride.. ¼ hour	184.5	166.8	90.0	9.1	5.0	8.6	5.0	21.3
Mercuric chloride.. sprinkled	174.7	149.8	85.7	12.7	7.2	12.2	7.0	31.4
Check	145.6	117.8	80.9	10.3	7.2	17.5	11.8	43.9

Table 2 presents the yields of the different plots calculated as averages for the treatments. After the total yield for each plot was determined the tubers were sorted into three classes, namely, primes, seconds and unsalable scabby. The latter class was composed of tubers covered with the scab lesions. Tubers showing only a few lesions were included in the primes. A count was then made to determine the per cent of scabby tubers in the primes. It will be

seen from the table that the benefits derived from seed treatment are not to be measured by the control of scab alone, since an increase in total yield resulted from all the treatments. The average for the formaldehyde treatments shows a gain of 24.6 bushels per acre over the check plots. The average increase for the mercuric chloride treatments was 33.9 bushels per acre.

Summary

1. Untreated scabby tubers gave a low yield, 11.8 per cent of which were unsalable on account of scab. The salable tubers were of low grade, 43.9 per cent being scabby.

2. Scabby seed treated with either mercuric chloride (1 to 1000) or formaldehyde (1 to 240) gave a better stand than untreated scabby seed.

3. Soaking scabby seed in either of these solutions led to increased yields.

4. The formaldehyde treatment for ½ hour gave a greater increase of salable primes than the 1-hour treatment.

5. The mercuric-chloride treatment for ¼ hour gave a greater increase of salable primes than the 1 or ½-hour treatments.

6. The 1-hour treatment with either solution gave slightly better control of scab than the shorter treatments.

7. Soaking the seed for 15 minutes in either solution gave very good control of scab and a marked increase in salable primes over the check plots.

8. Sprinkling tubers with either formaldehyde or mercuric chloride not only reduced the amount of scab but increased the total yield, indicating that this method has some value.

THE INFLUENCE OF SULFUR ON SOIL ACIDITY AND THE CONTROL OF POTATO SCAB

Wm. H. Martin

The investigations on the control of potato scab conducted by H. C. Lint (3) in 1914, 1915 and 1916 were resumed this year.

While the results of previous experiments with the use of elemental sulfur for the control of scab have been contradictory, the evidence as a whole indicates the possibility of its use in this connection. In view of the fact that potato scab is becoming more and more destructive, it was thought advisable that further research be conducted on this problem. Since the presence or absence of the scab organism appears to be determined to a large extent by the soil reaction, in the work this year particular attention was given to the relation of

the organism to soil acidity as measured by the hydrogen-ion concentration and the relation of the latter to the amount of sulfur applied to the soil.

Experimental

During the summer of 1919, five field experiments were conducted. These experiments were performed on soil of different types, including sandy loam, Sassafras loam and Penn loam. In selecting the fields in which the experiments were conducted, care was taken to avoid any marked soil irregularities so that differences arising from soil variations might be reduced to a minimum. As an additional precaution check plots were left between every two treated plots and each treatment was repeated at least three times. The size of the plots in the different experiments varied from 1/40 to 1/60 acre. Except for the sulfur treatments all the plots of an experiment were treated alike as regards fertilization and cultivation.

Sulfur was used in amounts varying from 300 to 1,200 pounds per acre. The sulfur used was the commercial flour sulfur. The applications were made broadcast after the land was harrowed and just before planting. In one of the experiments the sulfur was applied by hand, in two others a lime distributor was employed while in the remaining two the applications were made with a grain drill. The latter method proved the most efficient, since the sulfur was thoroughly mixed with the surface soil and a more uniform distribution was secured.

Experiments were conducted with the varieties American Giant and Irish Cobbler. When the potatoes were harvested they were separated into two classes, primes and seconds, the latter including all tubers under 1½ inches. The primes were then divided into classes depending on the degree of infection. In grading the primes of the American Giant variety, two classes were made, clean and scabby, the latter including all tubers showing any scab lesions. Three classes were made of the Irish Cobbler primes, namely, clean, salable scabby and unsalable scabby. The last class was made up of all tubers covered with the scab lesions, while tubers showing only a moderate infection were designated salable scabby. In this connection it must be stated that the percentage of salable scabby tubers in the primes is not a fair index of the actual control of scab since the salable scabby tubers from the check plots showed considerably more scab than those from the treated plots. This is particularly true of the American Giant variety; the primes in the sulfur-treated plots not only showed less scab than those from the check plots but were of a much better color and texture.

Before making the sulfur applications soil samples were taken in the area to be included in the experiment and the hydrogen-ion concentration of water extracts of the soil samples determined colormetri-

cally following the work by Clark and Lubs (1) in the preparation of the buffer mixtures, the selection of suitable indicators and with general methods of procedure. When the crop was harvested, soil samples were taken in each plot and similar determinations were made. In taking the soil samples borings were made to a depth of 6½ inches, at intervals of 15 feet. These individual samples were then thoroughly mixed and a sample taken to represent the condition of the plot in question.

In preparing the water extracts of the soil samples to be tested a method was adopted which was essentially the same as that employed by Gillespie and Hurst (2). To 15 gm. of air-dry soil which had been passed through a 1-mm. sieve, was added 30 cc. of distilled water in a 100-cc. Erlenmyer flask. The flask was then shaken 75 times, when it was allowed to stand for a time period of 8 to 12 hours. The supernatant liquid was then drawn off and distributed to test tubes.

The yields per acre as well as the percentage of scabby tubers is presented in the following tables, in which the data given are averages obtained from at least three replications of each treatment and of six check plots. The yields of second-size tubers are included in the tables; in view of the fact, however, that the sulfur treatments appeared to have no influence on the number of seconds they will not be discussed.

Experiments with Cobblers

Experiment I

The soil on which this experiment was conducted is a sandy loam. In 1912, an application of lime was made at the rate of 1,200 pounds per acre; since that time succeeding potato crops have been severely scabbed. Soil samples taken before the sulfur applications were made showed a hydrogen-ion exponent of 6.15. Sulfur was applied at the rate of 400 and 600 pounds per acre. The effect of the sulfur in total yield and scab control is shown in table 1.

It will be seen from the table that with both the 400 and 600-pound applications there was a marked gain in the number of salable primes with a corresponding decrease in the number of tubers rendered unsalable by scab. In addition to this the per cent of scabby tubers in the salable primes was greatly reduced. It will also be observed that with the increased application of sulfur there was a decrease in exponent values of the soil extracts.

TABLE 1

Influence of Sulfur Applications on Total Yield, Per Cent of Scabby Tubers and Hydrogen-ion Concentration

Treatment per Acre	Total Yield per Acre	Yield of Primes			Yield of Seconds per Acre	pH Values of Soil Extracts
		Salable Clean per Acre	Scabby	Unsalable Scabby per Acre		
	bu.	bu.	per cent	bu.	bu.	
Check*	350.1	163.5	64.6	146.8	39.7	6.03
400 lbs. of Sulfur†	339.1	265.8	29.4	30.2	42.6	5.20
600 lbs. of Sulfur†	342.7	283.2	19.4	25.9	33.4	5.07

* Average of 6 plots.
† Average of 4 plots.

TABLE 2

Influence of Sulfur on Total Yield, Per Cent of Scabby Tubers and Hydrogen-ion Concentration

Treatment per Acre	Total Yield per Acre	Yield of Primes			Yield of Seconds per Acre	pH Values of Soil Extracts
		Salable Clean per Acre	Salable Scabby	Unsalable Scabby		
	bu.	bu.	per cent	bu.	bu.	
Check*	174.0	70.4	57.6	85.9	17.7	5.57
300 lbs. of Sulfur†	181.4	144.6	22.4	24.1	12.7	4.77
600 lbs. of Sulfur†	171.9	132.0	23.8	22.9	17.1	4.82

* Average of 6 plots.
† Average of 4 plots.

Experiment II

The soil on which this experiment was conducted is a heavier loam than that on which the first experiment was performed. Sulfur was applied at the rate of 300 and 600 pounds per acre. The results of the sulfur treatment are given in table 2. As in the preceding experiment there was a marked reduction in the yield of unsalable scabby tubers on the treated plots, leading to an increase in the number of salable primes. The plots receiving 300 pounds of sulfur showed an increase in total yield, while the plots treated with 400 pounds of sulfur per acre showed a slight decrease. The differences in either case are small, however, and it is doubtful whether any importance can be attached to them. The initial hydrogen-ion exponent of this soil was 5.6 as compared with 5.57 for the check plots at the time of harvesting. A marked decrease in exponents resulted in the plots receiving the sulfur applications.

TABLE 3

Influence of Sulfur Applications on Total Yield, Per Cent of Scabby Tubers and Hydrogen-ion Concentration

Treatment per Acre	Total Yield per Acre	Yield of Primes		Yield of Seconds per Acre	PH Values of Soil Extracts
		Clean per Acre	Scabby		
	bu.	bu.	per cent	bu.	
Check*	144.3	128.4	60.0	14.7	6.27
300 lbs. of Sulfur†	147.0	135.4	43.6	11.6	5.90
600 lbs. of Sulfur†	134.4	119.4	26.9	15.0	5.83
900 lbs. of Sulfur†	156.2	141.8	26.3	14.1	5.13
1200 lbs. of Sulfur†	156.6	142.5	15.7	14.1	5.10

* Average of 8 plots.
† Average of 3 plots.

Experiment III

The soil on which this experiment was conducted is a Penn loam that had not been planted in potatoes for a number of years. To insure the presence of the scab organism in the soil, scabby seed was planted. Sulfur applications were made at the rate of 300, 600, 900 and 1,200 pounds per acre. The results of this experiment are given in table 3.

On the basis of total yield the plots treated with sulfur at the rate of 600 pounds per acre showed a decrease of 9.9 bushels per acre as compared with the check plots. Each of the other plots showed an increase in yield. This increase was 2.7 bushels, 11.9 bushels and 12.3 bushels per acre for the plots treated with 300, 900 and 1,200 pounds of sulfur, respectively. In this experiment no tubers were rendered unsalable by scab. From table 3 it will be observed that the per cent of scabby tubers in the primes decreased with the increased sulfur applications, the plots receiving the highest sulfur application yielding the lowest per cent of scabby tubers. With the increased application of sulfur there was a corresponding decrease in hydrogen-ion exponent values, the plots receiving the 1,200-pound treatment showing the lowest values and the lowest per cent (15.7) of scabby tubers among the primes.

Experiments with the American Giant Variety

Experiment I

The soil on which this experiment was conducted is a heavy loam that had produced severely scabbed potatoes the preceding year. Sulfur was applied at the rate of 300 and 400 pounds per acre. The results of the experiment are given in table 4. On the basis of total yield, the treated plots showed an increase over the untreated check plots, this increase amounting to 20.5 bushels per acre for the 300-pound treatments and 5.8 bushels per acre for the 600-pound treatments. From table 4 it will be seen that the per cent of scabby tubers in the primes was greatly reduced by the sulfur treatments. Of the total yield of prime tubers from untreated plots, 82 per cent were diseased while the plots treated with 300 pounds of sulfur per acre and those receiving the 400-pound treatment gave total yields of primes of which only 23.6 per cent and 15.8 per cent, respectively, were scabby.

The initial hydrogen-ion exponent value of soil extracts was 5.6 at the time of harvesting, average hydrogen-ion exponent value of soil samples from the check plots at time of digging was 5.55. It will thus be observed from table 4 that with each decrease in the value of the hydrogen-ion exponents below that of the check plots, a

corresponding decrease occurred in the per cent of scabby tubers among the primes.

TABLE 4

Influence of Sulfur Applications on Total Yield, Per Cent of Scabby Tubers and Hydrogen-ion Concentration

Treatment per Acre	Total Yield per Acre	Yield of Primes		Seconds per Acre	pH Values of Soil Extracts
		Clean per Acre	Scabby		
	bu.	bu.	per cent	bu.	
Check*	280.8	240.8	82.0	40.0	5.55
300 lbs. of Sulfur†	301.3	247.7	23.6	53.6	5.07
400 lbs. of Sulfur†	286.6	247.7	15.8	38.9	4.90

* Average of 6 plots.
† Average of 4 plots.

Experiment II

This experiment was conducted on a light sandy loam soil underlaid at a shallow depth by a greensand marl. In 1918 potatoes grown in the field had been severely scabbed. Sulfur was applied at the rate of 500 and 700 pounds per acre. The results are presented in table 5. The data of this table indicate a reduction of 44.8 bushels per acre for the plots treated with 500 pounds of sulfur in comparison with the corresponding yields from the check plots. It is questionable, however, whether this decrease in yield can be ascribed to the sulfur treatment, since the plots receiving the 700-pound application gave an increase of 3.5 bushels per acre over the yields from the check plots. A much lower percentage of scabby tubers was obtained from the treated than from the untreated plots. This decrease in the percentage of scabby tubers was much more pronounced than is apparent from the figures given in the table since the tubers from the treated plots classified as scabby showed fewer lesions than did those from the check plots.

In this experiment the amount of scab on the tubers from the treated plots was reduced to only a few lesions. It is doubtful whether scab could be entirely eliminated from the crop even by heavier applications of sulfur, since the exponent values resulting

from the 400 and 700-pound applications are considerably lower than the exponent shown in Gillespie (2) to inhibit the growth of the scab organism in culture media.

TABLE 5

Influence of Sulfur Applications on Total Yield, Per Cent of Scabby Tubers and Hydrogen-ion Concentration

Treatment per Acre	Total Yield per Acre	Yield of Primes		Yield of Seconds per Acre	pH Values of Soil Extracts
		Clean per Acre	Scabby		
	bu.	bu.	per cent	bu.	
Check*	247.3	184.4	64.4	62.8	5.6
500 lbs. of Sulfur†	202.5	161.2	28.8	41.3	4.8
700 lbs. of Sulfur†	250.8	191.6	23.8	59.1	4.8

* Average of 6 plots.
† Average of 4 plots.

Summary

With due regard for the limitations of the experiments here reported, resulting from the fact that they were conducted for one year only, the following points may be advanced.

1. With the different amounts of sulfur used, all gave substantial gains in the number of clean tubers. With the heaviest application, however, scab was not entirely eliminated.

2. The results would indicate that with those varieties of potatoes known to scab severely, the use of sulfur in the proper amount will render a large portion of the crop salable.

3. In all cases, following applications of sulfur, there was an increase in soil acidity as measured by the hydrogen-ion concentration of soil extracts. In most instances this increase in acidity, corresponding to a decrease in hydrogen-ion exponent, was in proportion to the amount of sulfur applied.

4. With a decrease in hydrogen-ion exponent there was a decrease in the number of scabby tubers.

5. The necessity of knowing the soil reaction before sulfur applications are made, is evident from the fact that where the hydrogen-ion concentration of water extracts of soil samples was 5,800 less, the lighter applications (300 to 500 pounds), gave approximately as good

control of scab as the heavier applications (700 to 1,200 pounds). Where the initial exponent was greater than 6.0 the heavier applications gave best control.

6. The results of the present work would indicate that the limiting exponent for the growth of the scab organism is lower in soil than in culture media.

References

(1) Clark, W. A., and Lubs, H. A., 1917. The colorimetric determination of hydrogen-ion concentration and its application to bacteriology. *In* Jour. Bact., v. 2, no. 1, p. 1-34; v. 2, no. 1, p. 109-136; v. 2, no. 3, p. 191-235.

(2) Gillespie, Louis J., and Hurst, Lewis A., 1918. Hydrogen-ion concentration—soil type—common potato scab. *In* Soil Sci., v. 6, no. 3. p. 219-236.

(3) Lint, H. C., 1914. Report of potato scab experiments. *In* N. J. Agr. Exp. Sta. 35th Ann. Rpt., p. 477-488; 36th Ann. Rpt., p. 375-381; 37th Ann. Rpt., p. 618-625.

REPORT OF CORN ROOT AND STALK ROT INVESTIGATIONS, 1919

I. C. Hoffman

Indiana Agricultural Experiment Station

in cooperation with

M. T. Cook

The experimental project in New Jersey was organized in cooperation with Dr. M. T. Cook, plant pathologist of the New Jersey Agricultural Experiment Station, and the plot was placed on the College Farm. The object of the experiment was to study the field performance of disease-free and diseased ears as determined by the germination test.

The seed was selected from New Jersey-grown stock at the instance of Dr. Cook and sent to Bloomington, Illinois, where it was germinated and examined by J. R. Holbert. From these ears enough were selected to form an ear-to-row plot of 99 rows. Enough corn was shelled and pocketed from each ear to plant a row. Whatever remnant ears were left were cared for by Mr. Holbert.

For the most part the rows were alternated between disease-free and diseased seed. It was not possible to carry out this plan of arrangement entirely on account of the limited number of ears available. The majority of the ears selected were run in duplicate, while a few others were added to the plot for special studies.

The spot selected for the plot was in the middle of a 7-acre field which was planted to the same kind of corn. At the north and south

ends of the field were patches of standing timber. A hedge of trees and shrubs connected these patches of timber on the west side of the field containing the plot, while four or five large trees stood along the east edge. In this manner the field was protected from high winds which tend to blow the stalks over.

The soil was a retentive loam which was very full of small pebbles and stones. It would probably be classed as a gravelly soil. It differed from the usual gravelly type in that it retained moisture usually well. The land sloped gently to the north and east with the highest part in the southwest quarter. However, the difference in elevation was slight.

The field consisted of an old timothy sod from which a crop of hay was taken in 1917 and 1918, as well as some previous to these seasons. In 1918 it was top-dressed with 300 pounds of acid phosphate and 100 pounds of sodium nitrate per acre. It was probably fertilized with a like amount in 1917, but positive information was not available. In 1919, at the time of plowing and preparing the seed-bed, 8 tons of manure and 450 pounds of acid phosphate and ammonium sulfate in the proportion of 3 to 1 by weight were applied per acre. The soil was plowed deep and harrowed thoroughly. The preparation of the seed-bed was done under the direction of the farm foreman, and labor for planting the plot was furnished by him.

Because of so much rain the planting had to be delayed until May 20 and 21. At this time the entire field was scored in both directions and the boundary of the plot marked by stakes. The rows contained 50 hills each, with 3 kernels of corn per hill. The kernels were placed in the hill by hand and were arranged in the position of an equilateral triangle to afford space for early growth and also to make a uniform type of hill for comparing the growth of the plants. This type of hill also lessened the danger of injury to the plants during cultivation. The kernels were covered with loose soil to a depth of 1 to 1½ inches. The covering also was done by hand to insure uniformity. The surrounding corn was planted with stab planters.

The corn seedlings came up between May 26 and 28, and on June 13 the first notes were taken on stand and vigor of the plants. On the same day, cultivation was begun and the first cultivation was completed on June 14. In all, three cultivations were given the plot during the season. More should have been given but it became impossible because of the lack of farm labor.

At the time of taking the first notes the plants were about the same size. They had become established and their roots were spreading in the soil. Evidence of disease was showing in occasional plants as indicated by lack of color and size. While the difference in size was not great, it was, however, sufficient to detect the strong, medium and weak plants. In several cases, the seed for planting certain rows was taken from ears which showed a large amount of infection with the ear rots. Rows 10, 17, 33 and 37 are examples of this,

and the effect on the original stand is very marked. Row 10 has 63 plants; no. 17 has 16; no. 33 has 89, and no. 37 only 9. In each of these rows the plants were very uneven in size and irregular in color.

A close examination of the ears from which the seed for each row was taken showed a marked difference in composition. The range ran from medium starchy, through various grades to very horny. Two classes, starchy and horny, were established based upon this factor, and the studies following will partially be based upon this condition in comparison with the disease character.

At the time the first examination of the plots was made the total stand was counted and a record taken of the strong, medium and weak plants in each row. Table 1 shows the correlation of initial stand to disease-free and diseased ears.

TABLE 1

Initial Stand June, 1919

Group	No. of Rows	Total Stand	Strong	Medium	Weak
		per cent	per cent	per cent	per cent
Disease-free	78	94.6	94.3	3.5	2.2
Ears with scutellum discolored	8	80.6	90.9	4.9	2.4
Diseased	11	79.3	84.0	9.2	5.8

The data here presented show that the disease-free ears gave a larger total per cent of initial stand and also a greater per cent of strong plants than those of the other groups. Consequently there were less medium and weak plants produced. The group with ears containing discolored scutellums, which were suspected of being diseased, produced an average stand of 80.6 per cent with a larger percentage of strong and fewer medium and weak plants than the diseased ears, but the stand and the vigor were somewhat less than those in the disease-free group.

Table 2 is a correlation between initial stand and composition in disease-free and diseased ears. The starchy corn produced a larger stand with a larger per cent of strong plants than the horny type in the disease-free group. In the groups of ears showing seedlings with discolored scutellums and disease, the larger stands were produced in the horny type while the largest percentages of strong plants came in the starchy type of seed.

In August the final counts for stand were made, as shown in table 3. The corn plants were practically full-sized and the ears had just been pollinated. As in the first count the disease-free corn maintained a decided increase in total stand over the other groups. The per cent of strong plants was decidedly greater and the percentages of medium and weak plants were significantly smaller than those in the diseased ears, respectively.

TABLE 2

Composition in Relation to Initial Stand, June, 1919

Composition	Disease-free Ears				Ears with seedlings showing discolored Scutellums				Diseased Ears			
	No. of Rows	Initial Stand	Strong Plants	Per cent Strong	No. of Rows	Initial Stand	Strong Plants	Per cent Strong	No. of Rows	Initial Stand	Strong Plants	Per cent Strong
Starchy	45	143	136	95.1	4	112	104	92.8	4	114	99	86.8
Horny	33	141	133	94.3	4	128	117	91.4	7	121	99	81.8

TABLE 3

Final Stand, August, 1919

Group	No. of Rows	Total Stand	Strong	Medium	Weak
		per cent	per cent	per cent	per cent
Disease-free	78	92.6	91.3	4.2	5.0
Ears with scutellum discolored	8	77.3	93.0	0.8	6.0
Diseased	11	76.0	77.1	11.4	12.2

Ears showing seedlings with discolored scutellums had a much smaller stand than the disease-free ears, and slightly greater than those from diseased ears.

The differences between the stands of the disease-free and diseased rows at the beginning and the close of the season remained relatively the same, indicating that when the plants of disease-free or diseased seed are once established in the soil, both classes are subjected largely to the same influences that effect mortality.

In comparing the effect of the composition on the stand in rows planted with disease-free and diseased seed at the end of the season, it is observed in table 4 that the same facts hold that were found at the beginning of the season. The starchy corn produced a greater stand than the horny ears. The total number of plants from the horny diseased type is considerably reduced in comparison with the same type from the disease-free seed, and the number of strong plants is large in proportion to the total stand.

TABLE 4

Composition in Relation to Final Stand, August, 1919

Composition	Disease-free Ears				Ears with seedlings showing discolored Scutellums				Diseased Ears			
	No. of Rows	Final Stand	Strong Plants	Per cent Strong	No. of Rows	Final Stand	Strong Plants	Per cent Strong	No. of Rows	Final Stand	Strong Plants	Per cent Strong
Starchy	45	140	132	94.3	4	107	100	93.4	4	112	97	86.2
Horny	33	138	119	86.2	4	125	122	97.6	7	116	83	71.5

The group of ears with seedlings showing discolored scutellums varied somewhat during the season. The horny type of kernels maintained a larger stand and also attained a higher per cent of strong plants, whereas the starchy type had a larger per cent of strong plants at the time the initial count was made. The horny type in this case had a smaller stand than either group in the disease-free ears, and larger than the same groups from the diseased ears. The starchy corn in this same group produced the lowest stand of any group, but ranked third in per cent of strong plants. All of this indicates that for conditions obtaining at New Brunswick, the disease-free ears of the medium starchy type will produce the greatest total stand and the largest number of strong plants.

Progress of the diseases on the young corn plants was observed by the characteristic chlorosis and wilting effects. In the worst cases

they resulted in blighting and death to the plants. In others, the plants were sufficiently resistant to the disease so that they grew slowly and produced what were classed also as medium and weak plants. Plants that started out as medium and weak ones usually remained as such, except as a medium plant would become weak, or a weak one die through the progress of the disease.

Later, when the stalks were about full grown, an index to the root development was given through the numbers of broken and down stalks. Just before harvest time, this condition was at its worst. The leaning, broken and down stalks were not confined to definite rows but were generally found in the entire plot. The stalks did not lie in a single direction as if a high wind had blown them over, but they seemed to fall in all directions, leaving the plot in bad condition for harvesting. From what is known of the effect of root development on the ability of corn to stand up, it appears that the root systems of the plants in this soil were badly infested. However, no examinations were made so no conclusions can be drawn.

TABLE 5

Composition in Relation to Yield, 1919

Composition	Disease-Free Ears		Ears with Seedlings Showing Discolored Scutellums		Diseased Ears	
	No. of Rows	Yield	No. of Rows	Yield	No. of Rows	Yield
		bu.		bu.		bu.
Starchy	45	76.05	4	73.48	4	55.73
Horny	33	67.07	4	71.00	7	50.98

The corn surrounding the plot was cut and shocked when it was sufficiently matured. The plot was left uncut and allowed to ripen as normally as possible. Labor for husking and storing the crop was furnished by Dr. Cook and the farm manager. As soon as the corn had dried sufficiently the ears were husked from the uncut stalks and carried in baskets to the east end of the rows and piled separately. The yield of each row was then weighed accurately on platform scales and the weights recorded, after which the corn was turned over to the farm manager.

The yields of the various groups with respect to disease and composition are given in table 5.

Three sets of comparisons are presented with respect to composition and disease characters.

The yield of starchy corn is 8.98 bushels per acre larger than that of the horny corn in the disease-free group. It was 2.48 bushels greater in the group of ears showing seedlings with discolored scutellums, and 4.75 bushels greater in the diseased group of horny seed. The starchy disease-free group yielded more than any other group and the horny diseased group yielded the least.

TABLE 6

Yield Data, October, 1919.

Row No.	Yield Per Acre	Row No.	Yield Per Acre	Row No.	Yield Per Acre
	bu.		bu.		bu.
1	67.13	34	70.21	67	89.92
2	81.29	35 SD	77.15	68	82.45
3	60.51	36	84.68	69	78.22
4	52.19	37 D (out)	5.23	70	66.50
5	51.27	38	92.53	71	66.67
6	63.74	39 SD	66.05	72	83.30
7	64.20	40	80.99	73	74.98
8 D	50.81	41 D	64.67	74	82.37
9	60.51	42	74.06	75	86.53
10 D	25.25	43 D	59.12	76	70.82
11	51.73	44	67.13	77	62.36
12 D	49.88	45	52.88	78	67.44
13	54.50	46 SD	79.14	79	67.90
14	58.20	47	72.21	80	73.13
15	50.81	48	79.89	81	85.53
16	53.58	49	82.79	82 SD	68.95
17 D (out)	3.38	50	77.29	83	81.91
18	62.86	51	66.20	84	74.06
19 D	43.26	52	81.91	85	103.31
20	63.74	53	57.13	86 SD	66.97
21	90.38	54	75.29	87	65.59
22	50.81	55	86.53	88	80.52
23 D	53.58	56 SD	73.13	89	60.05
24	45.26	57	72.60	90	80.52
25	59.12	58	74.98	91	68.98
26	65.13	59	85.14	92	91.15
27 SD	71.59	60 SD	74.98	93	62.05
28	70.82	61	68.98	94	87.30
29 D	60.42	62	74.98	95	79.14
30	66.50	63	69.44	96	72.60
31 D	71.59	64	87.45	97	94.07
32	63.74	65	66.67	98	82.37
33 D	48.96	66	70.36	99	74.98

SD—Scutellum discolored.
D—Diseased.
Unmarked row numbers—Disease-free ears.

FUNGI INJURIOUS TO PAINTS

C. M. Haenseler

Studies on fungi injurious to paints were begun in July, 1916, and carried on until September, 1917, at which time the writer entered military service. The studies were resumed again in September, 1919, and are still in progress.

The problem was considered in a very general way and an attempt was made to make a survey of the field as a whole, rather than to undertake an exhaustive study of any particular phase. Attempts were made through observations and experimental studies to throw light on the following:

1. The prevalence and economic importance of fungous injury to paints.
2. The species of fungi causing the injury.
3. The nature of the injury.
4. The source of food for these fungi.
5. The environmental conditions necessary for their development.
6. The relative growth of fungi on paints of various composition and on paints applied to various woods.
7. Possible control measures.

Fungi growing on painted and varnished surfaces have been found to be very generally distributed and of much more common occurrence than heretofore has been suspected. They are found abundantly both on exterior and interior painted surfaces, wherever the proper conditions are presented.

It is difficult to get even an estimate as to the economic importance of these paint-inhabiting fungi. Apparently the only direct reference which is printed concerning losses of paint due directly to fungi, is given by Massee (2), who states that in one case a number of newly painted greenhouses had to be repainted on account of a severe reddening of the wet paint due to the presence of a fungus growth. Such a complete ruination of a freshly applied paint is doubtless very rare. The greater injury is caused by the blackening and mottling of white painted surfaces after a considerable length of time. In such cases the surface finally becomes so unsightly that a new application of paint must be made on account of the appearance, long before the old coat has lost its real protective power.

The species of fungi found on painted surfaces are quite numerous but the forms which are constantly associated with paint discoloration are relatively few. Such forms as *Alternaria, Aspergillus, Penicillium, Sporotrichum* and various yeasts and bacteria are frequently gotten in petri-dish cultures from discolored paint surfaces but these forms are usually not the cause of the discoloration. In certain cases *Aspergillus* and *Penicilium* have been found to be the principal fungi present and the sole cause of the discoloration, but they have not been found to be very prevalent. Bacteria and yeast are found only on very moist surfaces and are unimportant in connection with these studies.

Dematium pullulans DeB. & L., several species of *Cladosporium*, two species of *Phoma* and an unidentified fungus with a red-brown mycelium have been found to be the important species causing discoloration on painted surfaces. *Cladosporium* and *Aspergillus* have been found causing considerable injury to varnished surfaces.

Each species causes a specific type of spotting or discoloration, and as a rule, the species of the fungus can be determined from the characteristics of the colonies and the color produced on the underlying paint.

The discoloration of the paints may be due to the presence of black or brown hyphæ or resting bodies (*Dematium, Cladosporium, Phoma* sp.), or to the presence of masses of highly colored spore masses (*Aspergillus, Penicilium*), or to the production by the fungus of soluble pigments which discolor the paint itself (*Phoma pigmentivora*). Discoloration varies, with the species, from a very uniform darkening of the entire surface (*Dematium*) to small black specks (*Cladosporium*) or to large irregular red, or reddish brown blotches (*Phoma* sp.).

Careful observations and experiments have been made to determine the source of food of the paint-inhabiting fungi. A series of experiments were made to test the ability of the various fungi to use linseed oil as a food. None of the fungi were able to derive their full nourishment from the oil. In agar containing nutrient salts, however, they were able to break down the oil and utilize it as a source of carbon. Panel tests seem to indicate that the fungi are unable to make an appreciable growth on perfectly clean painted surfaces. A very small amount of nourishment added to the surface allows a considerable growth. Whether or not the fungi are able to attack the oxidized oil film and utilize this as a source of energy has not been determined definitely. Observations and experiments seem to indicate that, as a general rule, the fungi which grow on painted surfaces, especially those which produce colonies, derive their nourishment from foreign matter which happens to be on the paint, but that in certain cases it seems probable that they may utilize the oil of the paint or its disintegration products as a source of energy.

The environmental conditions to a very large extent control the presence of fungi on paints. In greenhouses with relatively high temperature and humidity these fungi are most prevalent. Even in the greenhouse certain species are very localized on account of the favorable environments at certain points. Other species, such as *Dematium pullulans*, are very indifferent and may grow luxuriantly either on moist or dry interior surfaces or on exposed exterior surfaces.

A large number of panel tests have been conducted to determine the relative growth of fungi on the various types of paint. White lead (carbonate), white lead (sulfate), zinc oxide, lithopone, a mixed paint (50 per cent lead, 50 per cent zinc) and a ready-mixed commercial paint were included in the tests. Some of these panels were exposed to the atmosphere and natural infection in greenhouses;

other small panels were inoculated with pure cultures and exposed in aerated moist chambers. Some of the tests were made by applying the paints directly to the interior wood and steel work of a greenhouse. The panels have been exposed for from 6 months to 3 years, the majority of the panels still being under observation. The greenhouse and laboratory panels, as well as general observations, show that lithopone is readily subject to fungus attack. Even after 6 months' exposure lithopone showed very severe blackening due to fungi. Next to lithopone, pure white lead (carbonate) is the most subject to attack. The pure lead panels in all cases showed severe blackening and spotting due to fungi, while zinc oxide and mixed paints showed only occasional colonies.

Culture tests were made to test the relative toxicity of lead carbonate, lead sulfate and zinc oxide pigments. Lead carbonate proved to be the least toxic. Zinc oxide was the most toxic to some of the fungi, lead sulfate to others. The fungi were able to grow in the presence of large amounts of all of these pigments.

Tests to determine whether the purity of the linseed oil used in mixing paints affected the fungus growth on these paints failed to show any noticeable difference between ordinary linseed oil and a special purified grade.

White pine, spruce and cypress panels, when painted with the same paint, all developed fungi alike. The different woods did not affect the kind or amount of growth.

A series of panel experiments were conducted to determine the possibility of preventing the growth of fungi on paints by means of adding various antiseptics and poisons to the paints before application. One per cent by weight of copper sulfate, 4 per cent of benzol and 2 per cent of mercuric chloride, zinc chloride, carbolic acid and toluene, respectively, were added to the second coat of paint before application. All of these treated paints developed a good growth of fungi. *Dematium* and *Cladosporium* developed on all the paints alike. The *Phoma* sp. and the red-brown unidentified fungus seem to be more sensitive to the antiseptics. These species were found to have somewhat less growth on paints treated with copper sulfate and mercuric chloride. Although Massee (2) and Gardner (1) have recommended antiseptics as a control for fungi on paints these tests seem to indicate that antiseptics and fungicides added directly to the paints are not especially effective.

The studies on fungi injurious to paints are still in progress. The laboratory tests and greenhouse panels will be continued for at least another year before a final report is made.

References

(1) GARDNER, H. A., 1913. Notes on the formation and inhibition of mildew in paints. *In* Jour. Franklin Inst., Jan. 1913. p. 59-64.

(2) MASSEE, G., 1911. A new paint destroying fungus. *In* Roy. Gard. Kew, Bul. Misc. Inform., no. 8 (1911), p. 325-326.

Ramsbottom

CELERY DISEASE INVESTIGATIONS

ROBERT F. POOLE

Experiments conducted by W. S. Krout in 1916 and by the writer in 1917 in the Oradell-Ridgewood region of Bergen County have in part been continued. Some of the chemical disinfectants applied to the diseased areas have been eliminated, because toxicity resulted in some cases without control of the diseases. Other compounds which gave promise of control were applied this season in greater amounts. Data to be collected during the summer may warrant recommending positive or negative results so far as applying chemical compounds to the soil for the control of the soft rot organism is concerned. We are more interested in controlling the disease from a practical standpoint, which interests the farmer. Sterilizing the greenhouse beds with steam or formalin is a valuable asset to every farmer, and when properly applied, damping-off and root-rot diseases are readily controlled in the seed-beds. Hardy green celery varieties have never been as susceptible as the golden self-blanching varieties. In the past few years, however, a great many diseased plants of the green varieties have been seen in the field. The symptoms are the same in all respects as those of the yellow varieties. The bacterial disease has spread to most of the muck-soil farms. Temperature is a great factor because golden self-blanching varieties grow well on diseased muck lands from April to July. After this period, growing golden self-blanching celery results in a complete failure on infected muck soils.

Copper sulfate, ferrous sulfate, hydrochloric acid, potash, phosphoric acid, lime, sulfur, cyanamide and other compounds were applied to the infected land this season in various amounts to determine their effect as disease controls.

Seedling plants were treated in mercuric chloride, 1 to 1,000, for 3 and 5 minutes. Some of the former lived, but even this short exposure was too great for the tender roots and the plants grew very slowly. A copper sulfate solution, 1 pound to 50 gallons of water, gave similar results, but further treatment of this nature was discontinued because of toxicity and stunting of plant growth. Weaker solutions of these disinfectants could not be depended on to control the organism.

Transplanting may prove beneficial; however, plants grown at the Experiment Station in sterilized sandy loam, became diseased in a few cases when grown in infected muck soil. Further trials of transplantings may be worth while.

Very vigorous strains of golden self-blanching celery growing in diseased areas have encouraged breeding for strains resistant to the root rots. Forty mature stalks of celery collected from the diseased

areas were transplanted from the fields into the plant pathology greenhouse at the Experiment Station in November, 1919. Practically all of the plants grew well for a few weeks, some for 4 months. High temperature and high humidity late in November developed and the dormant organism became active to such an extent that 25 of these stalks died in one week by decaying in the heart. Ten more of the plants died in the latter part of March, 1920. Five of the 40 plants selected showed no sign of disease during the winter. Of the seed that formed, some was distributed for quick trial among several of the best celery growers of Bergen County on June 23. This seed will be given a better test next year. If infestation becomes very serious on green celery varieties, strong strains of these varieties will be selected for seed. Celery seeds more than three years old germinate poorly. The vitality of golden self-blanching celery seed is poor in comparison with that of the green celery varieties. From this standpoint alone, we cannot lay too much emphasis on advantages gained by selecting stalks which will produce the very best of seed. Every grower of celery should take pride in growing seed from his own stock, which will give strong plants to begin with.

The organism causing celery root rot has been isolated. Numerous infection experiments have proven its pathogenicity. Green celery varieties and other vegetables have been inoculated with the organism with success. High humidity with a temperature above 80° F, is most favorable for developing soft rots caused by this organism. The number of this organism, following the outline formulated by the Society of American Bacteriologists is 221–1,113,523. Wormwald (2) described an organism with this same number and named it *Bacillus apiovorous*. *Bacillus carotovorous* Jones (1) is perhaps the same organism, or they are two of many strains of a bacillus which produces soft rots of vegetables and other foods. The only contrast between the two organisms as compared by Wormald was a few minor differences of growth in synthetic culture media and the fact that his organism produced yellow chromogens. *Bacillus carotovorus*, on the other hand, was described by Jones as non-chromogenic. The organism isolated is very variable in results unless it is kept revigorated. Carrots became diseased on the diseased muck soil as severely as golden self-blanching celery, and no distinction could be made from the organisms isolated from the celery and carrots. We doubt, therefore, whether even strains of this soft rot bacillus should be given as different species. Experiments have shown that the character of rot symptoms is due entirely to the physiological conditions of both host and parasite.

References

(1) Jones, L. R., 1900. A soft rot of carrot and other vegetables. *In* Vt. Agr. Exp. Sta. Ann. Rpt. (1900), p. 299-332.

(2) Wormald, H., 1913. A heart rot of celery caused by bacteria. *In* Jour. Southeast. Agr. Col. Wye, no. 22 (1913), p. 457-473.

HORSE-RADISH ROOT ROT INVESTIGATIONS

ROBERT F. POOLE

In the past few years much horse-radish root rot has been reported from Passaic County. The annual losses, however, do not exceed 2 per cent. The cause of the disease is a bacterium. The disease occurs in a general way, well distributed in the field. Historic facts concerning the disease are more or less conflicting. Some of the older growers claim that they have detected the horse-radish root rot for many years in their fields. Other growers claim that the disease was introduced in the past 4 or 5 years.

The symptoms of the horse-radish root rot are most pronounced about harvest time. The rot is confined to the core of large roots. Rarely if ever is the outer wall attacked. Unless the growers keep the head roots stripped off, there is no way of estimating the amount of diseased roots in a field. The head root system would keep the plant in a growing state even though the main root was decaying. If the head roots are stripped back and the root is infected, wilting and death will result on drying hot days. The rate of transpiration would be too great for the diseased end roots. If one end of a root is badly diseased when it is planted, decay is encouraged by rodents, saprophtic fungi and bacteria. Rodents eat through the outer walls of the roots and soft decay sets in. The interior of a horse-radish root shows a distinct line of demarkation. An outer zone of healthy tissue encloses a core of decaying, water-soaked tissue which is yellowish in color and contains great numbers of bacteria. In older roots a distinct slackening occurs and very old roots become hollow. The horse-radish root is a good medium for the growth of both bacteria and fungi.

Rhizoctonia sp., *Penicillium* sp., *Thielavia basicola* and *Rhizopus* sp., have been constantly isolated from specimens of horse-radish sent to the laboratory and also from many diseased roots found during seed selection. Some of these fungi are known to cause rots of sweet potatoes and other root crops in storage and their relation to the horse-radish rots will be studied in the future.

The general nature of the disease leads us to believe that the disease is present in the horse-radish roots when they are set in the field. Mr. Fisher, a Passaic County farmer, has agreed to cooperate with us in this work. Mr. Wettyen, county agent of Passaic County, also has assisted us in starting the investigation of horse-radish diseases. Experiments are being carried on along the following lines:

1. Selection of disease-free roots for planting.
2. Disinfecting roots with formaldehyde and corrosive sublimate.
3. The effects of acid and alkali soils on the organism.
4. Better methods of storing seed-roots over winter.

The systematic nomenclature of the organism is being studied. It has been isolated and its pathogenicity proven.

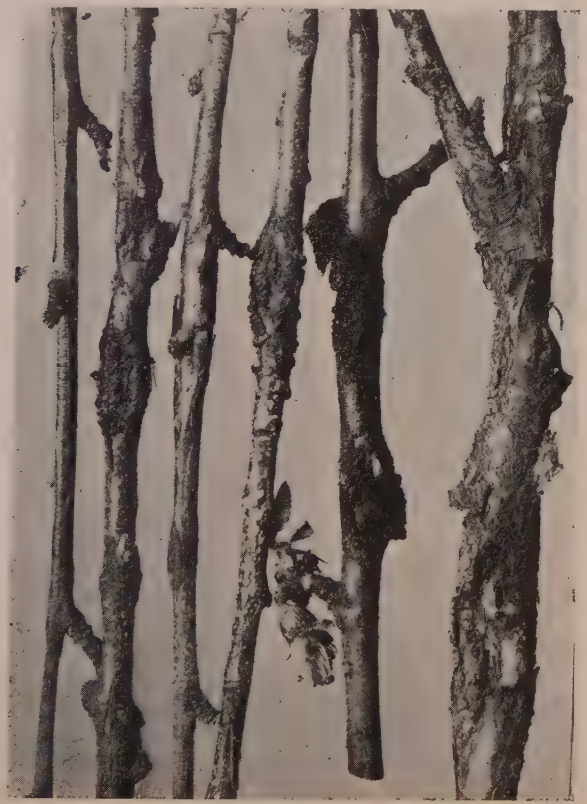

FIG. 1. Brown rot of peach showing infected twigs

FIG. 2. Brown rot of peach showing infected twigs

FIG. 1. Brown rot of peach showing infected blossoms and foliage

FIG. 2. Root rot of celery

FIG. 1. Late blight of celery. Photo taken immediately after the first frost, killing all the leaves that were infected. Killed leaves drooping over edge of boards

FIG. 2. Close view of plants infected with late blight (*Cercospora apii*)

FIG. 1. Pepper seedlings damping off with *Rhizoctonia*

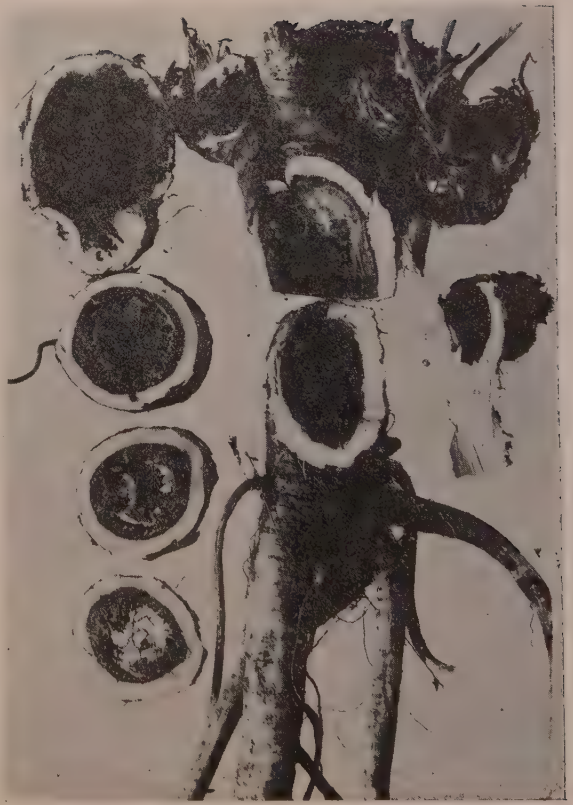

FIG. 2. Bacterial root rot of horse-radish

PLATE 5

POTATO SPRAYING TEST -Every Other Four Rows Sprayed with Bordeaux Mixture

PLATE 6

FIG. 1—Yield of Prime Tubers from Seed Treated with Formaldehyde for Scab Control Compared with Yield from Untreated Seed
(From N. J. Agr. Exp. Sta. Cir. 122)

FIG. 2—Unsalable Scabby Tubers from Plots Treated with Sulfur for Scab Control Compared with Those from Untreated Plots
(From N. J. Agr. Exp. Sta. Cir. 122)